125 Years in the Chemistry Department at Wellesley College: 1875-2000

Nancy H. Kolodny, Jeanne A. Darlington, Helen C. Mann and Eleanor R. Webster

ABSTRACT

The goal of Wellesley College's Founder, Henry Fowle Durant, was to promote "radical change in the education of women." Beginning in 1875, the Scientific Course was designed to give "opportunities for women … substantially the equivalent of those given to young men in the best Scientific and Technical Schools." In addition to preparing teachers, the course was to "open the way for future study [and to] provide satisfactory preparation for those who intend to become physicians." Determined to have an all-female faculty and to introduce the new teaching techniques in science emphasized in Germany, Durant insisted that the students, from the beginning of the course until the end, were to "receive practical instruction in the Laboratory." This paper will present the development of the education of women in chemistry from the founding of Wellesley College in 1875 to the present in the context of such external factors as the availability of trained female instructors, two world wars, and government funding.

Table of Contents

Introduction 3
1875-1893: The College Hall Era 4
The Place of Science in the College Curriculum 4
The Physical Facilities of the Chemistry Department 7
The Faculty of the Chemistry Department 8
Curriculum and Instruction in the Chemistry Department 9
The Early Students of Wellesley College and the Post-College Lives 9
1894-1935: The "Chemistry Building" Era 11
The Place of Science in the College Curriculum 11
The Physical Facilities of the Chemistry Department 12
The Faculty of the Chemistry Department 14
Curriculum and Instruction in the Chemistry Department 15
Laboratory Instruction 15
The Impact of World War I 16
Faculty/Student Research in Chemistry 16
The Post-College Lives of Wellesley Chemistry Majors 17
1936-75: The Pendleton Hall Era 18
The Place of Science in the Wellesley College Curriculum 19
The Physical Facilities of the Chemistry Department 21
The Faculty of the Chemistry Department 23
Curriculum and Instruction in the Chemistry Department 23
Laboratory Instruction 25
Faculty/Student Research in Chemistry 26
The Post-College Lives of Chemistry Majors 27
1976-2000: The Science Center Era 28
The Place of Science in the Wellesley College Curriculum 29
The Physical Facilities of the Chemistry Department 29
The Faculty of the Chemistry Department 31
Curriculum and Instruction in the Chemistry Department 32
Laboratory Instruction 33
Faculty/Student Research in Chemistry 33
The Post-College Lives of Chemistry Majors 34
Conclusion 34
Acknowledgements 35
ENDNOTES 35

Introduction

This history of Wellesley's Chemistry Department is an attempt to understand the development of a women's liberal arts college science department in the context of relevant external factors during the period 1875-2000. We have divided the study into four eras, named after the four buildings at Wellesley in which chemistry was taught during these years.

- 1875 - 1893 The College Hall Era
- 1894 - 1935 The "Chemistry Building" Era
- 1936 - 1975 The Pendleton Hall Era
- 1976 - 2000 The Science Center Era

For each era, the paper seeks to place the department's development within several overlapping contexts:

- local, national and world events
- U.S. science policy and external support for science
- chemistry as taught and "practiced" externally
- higher education and employment of women

We have had to be very selective in identifying external factors that had an impact on the teaching of chemistry at Wellesley. Others might identify an entirely different group of external factors, or dispute the importance of those we have chosen. Also, for each era we have focused on a specific group of internal characteristics, including:

- the place of science in the overall college curriculum
- the physical facilities of the Chemistry Department
- the faculty of the Chemistry Department
- curriculum and instruction in the Chemistry Department, particularly laboratory instruction
- faculty/student research in chemistry
- the post-college lives of students who majored in chemistry.

For the history of the first three eras we have depended on documentation from the Wellesley College Archives, and issues of the College's alumnae publications, and some interviews. For the most recent era, in which we have been full participants, the source of information is largely our own experience. For the authors of this paper, a history of Wellesley's Chemistry Department is **our** history. Our associations with this nearly 125 year old department range from almost half of its history to about a quarter of it. Thus, while it has been relatively easy, apart from some natural sentimentality, to maintain a distance from the early history of our department, our recounting of the more recent history naturally reflects our own experiences and opinions.

1875-1893: The College Hall Era

- In 1875 ten years had passed since the end of the Civil War, and the United States was in a period of high optimism and economic expansion resulting, in part, from the implementation of the industrial revolution.

- Federal funding for science was virtually non-existent. During the Civil War, the Union Army had benefited from earlier research supported by the federal government on the development of weapons with interchangeable parts. Aside from this, growth in agriculture had been the only beneficiary of federal funding for "science."[1] Basic research in science, when supported at all, "was supported by organized philanthropies created during the economic expansion that followed the Civil War."[2]

- The American Chemical Society was about to be born in 1876, following discussions at an 1874 Priestley Centennial meeting (at which the 3 women attendees did not appear in the official photograph).[3] Most professional chemists "did routine testing for industrial concerns, performing analyses based upon classical gravimetric and volumetric methods."[4] Our modern ideas of atomic structure were decades away. In most colleges little provision had been made for teaching chemistry by 1875.[5] While the years after the Civil War "marked a time of transition for chemical instruction, from ideas rooted in natural philosophy courses to methods drawn from new ideas in research science," change came slowly at the college level.[6] For example, in the mid-1870's only the Massachusetts Institute of Technology, the University of Pennsylvania and the University of Virginia reported laboratory work in organic chemistry.[7]

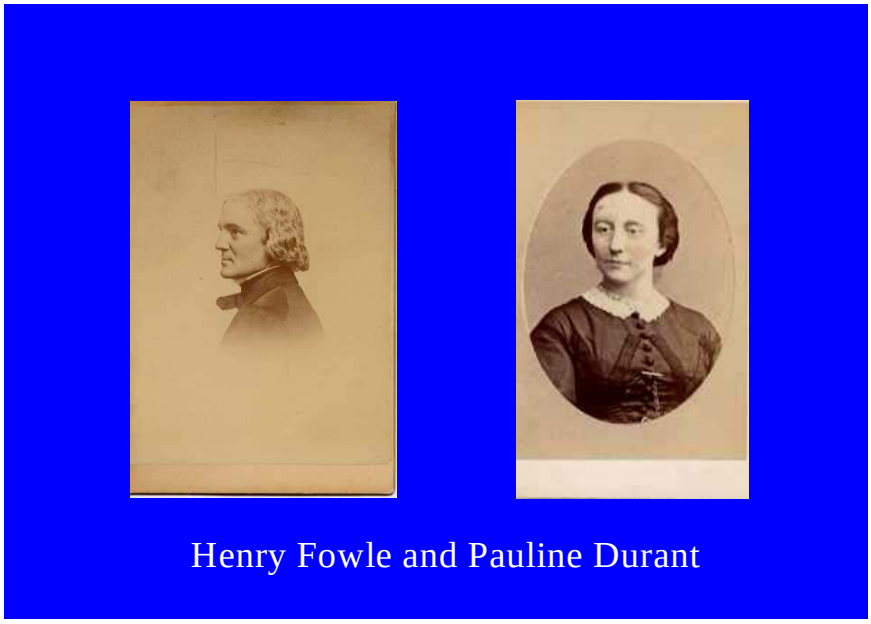
- Only about 1% of the eligible population attended college in 1875.[8] For women at that time, higher education was available at a few "female seminaries," such as Mt. Holyoke, founded in 1837, at Vassar College, founded in 1865, at one or two coeducational colleges, such as Oberlin, which had admitted women since 1833, and, beginning in 1870, at a few state universities such as the University of Michigan.[9]

The Place of Science in the College Curriculum

In the fall of 1875 the first students entered Wellesley College. They encountered a curriculum that included four years of math and science among its requirements. How did this college come to be, and what were the expectations of the founders, the faculty, and the students? How did math and science come to play such a central role?

The early history of Wellesley College has been eloquently (and somewhat variously) described in several books[10,11,12, 13] All of the histories agree that the College's founders, Pauline and Henry Fowle Durant (Figure 1) had extremely strong opinions about what they wanted their college to be.

Figure 1



Henry Fowle Durant, an attorney practicing in Boston, Massachusetts, built Wellesley College on the 300 acre site in West Needham he had purchased to be a home for his son. When his son died of diphtheria at age 11, a despondent Mr. Durant left his Boston law practice and moved to New York. There he made a great deal of money during the Civil War. He also accepted his wife's devout evangelical Christianity and became a lay preacher in his own right. Contributing to Mr. Durant's ideas about what a college should be were his service as a Trustee of Mt. Holyoke Seminary. Horowitz contends that Durant "decided to put a Mt. Holyoke on his estate in Wellesley, Massachusetts. Only, he wanted to do what Mary Lyon, with her plain style and limited means, could not and would not: he meant to make his female seminary the most beautiful the world had ever seen."[14] Mr. Durant built Wellesley both spiritually and physically: he helped supervise the construction of College Hall (Figure 2a), chose the furnishings, etc. In 1870 Durant petitioned the state legislature for a charter for Wellesley Female Seminary. In 1873, having learned about Vassar's status as a college, he petitioned the legislature to change his school's name to Wellesley College.[15]

Among Mr. Durant's strong opinions, and, therefore, among Wellesley's earliest characteristics, were that the College would have an all-female faculty and administration. Wellesley would be an all-encompassing academic and residential community in which faculty and students would live together in the beautiful and immense College Hall. All students (and faculty) were to engage in the serious and continuing study of the Bible, as part of an academic program designed to prepare young women to enter the world as teachers or other professionals.

Figure 2a

College Hall

Wellesley College opened its doors in 1875 offering two courses, the General, or Classical, Course and the Scientific Course. The development of the Scientific Course, especially with its laboratory emphasis, was influenced strongly by Mr. Durant's friendship with Eben Norton Horsford, Rumford Professor of Applied Science at Harvard in the mid-nineteenth century.[16] Professor Horsford, who shared Mr. Durant's ideals with respect to women's education[17] was the first director of the Lawrence Scientific School, founded in 1842 and eventually affiliated with Harvard College. Horsford had trained with Liebig at Giessen, and engaged in diverse activities as teacher, chemical manufacturer (he made his fortune on baking soda), and antiquarian.[18] He was the first President of Wellesley's "Board of Visitors" and a major benefactor of the College, donating $120,000 in 1878 for "the Library, for scientific apparatus and for pensions and grants to the faculty."[19] In addition to all this, Professor Horsford helped Durant select the first women science faculty and advised him on the curriculum and construction of laboratories.[20]

Wellesley College's early emphasis on science was not limited to the Scientific Course. From 1875 and throughout the 1880's, all students in the Classical Course as well were required to take Mathematics in the first two years, General Chemistry as sophomores, Physics as juniors and "Mental Science" (psychology and philosophy) as seniors. They could take further Chemistry (or other science) courses as electives.

The Scientific Course was described in the Wellesley College Calendar (in 1877-78) as intended

> for those who desire to give the four years of College life to the pursuit of the Natural, Physical and Mathematical Sciences, and the studies necessarily connected therewith. It is intended to meet the imperative demand in the higher education of women for more extended and thorough instruction in the Sciences. The course, as laid out, gives opportunities for scientific study which are substantially the equivalent of those given to

> young men in the best Scientific and Technical Schools. … The present course is arranged to meet the wants of teachers; to open the way for future special study; and also to provide satisfactory preparation for those who intend to become physicians.[21]

In the 1881-82 College Calendar we see the details of the Scientific Course:[22]

- 3 or 4 years of French and German
- 4 years of Mathematics
- 2 or 3 of Chemistry "with Laboratory Practice"
- 2 or 3 years of Botany
- 1 year of Mineralogy, Crystallography, Lithology and Geology or Zoology and Physiology
- 1 year of Physics
- Each year a course called "History; English Literature; Essay Writing"

Wellesley College was described to the American public by Edward Abbott in an August 1876 article in Harper's New Monthly Magazine. His article is a fascinating, detailed description of the College, complete with beautiful sketches of the landscape and architecture. Mr. Abbott introduced his article with the statement that "[A] view of such an institution as Wellesley College becomes … an important part of the general inspection we are all now so much interested in making for the measurement of the century's progress."[23] Abbott told the readers of Harper's that "[I]t is the intention to graduate from Wellesley students who shall be fully on a par in scholarship with graduates of Harvard and Yale." According to Hackett[24] this article "attracted the attention of many parents and daughters to this most magnificently equipped of women's colleges…."

The Physical Facilities of the Chemistry Department

The facilities available to the earliest students and teachers of chemistry (Figure 2b) are described in the 1877-78 College Calendar as follows:

> in the department of Chemistry and Mineralogy there are two laboratories ["furnished with cupboards and drawers for ninety-six students working in divisions"], a lecture-room, and a store-room for apparatus….The laboratory and lecture room are thoroughly ventilated, and fully supplied with all the chemicals and fixtures which can be desired.[25]

Figure 2b

General Chemistry Laboratory, College Hall, 1893

During the 1880's Chemistry, along with Mineralogy and Botany, acquired more space in College Hall as well as the new Stone Hall,[26] but by 1888 Chemistry was complaining of "too cramped space…One of the very urgent needs of the department is a private laboratory for the professor and instructors."[27] Increasing enrollments and "unfit" laboratory space resulted in teaching Organic Chemistry without laboratory work in 1892-93. Concerns about lack of adequate space were to recur periodically over the next 80 years, with three new buildings being constructed during that period.

The Faculty of the Chemistry Department

Who were the faculty Mr. Durant found to teach in his college? Where and how were they trained? "There was practically no graduate work in chemistry given in America [as late as] 1870."[28] Before this time, any American man (and they were virtually all men) who wanted a doctorate in chemistry had to go abroad for graduate work, in the early days to Paris, and later to Giessen. Since there were few opportunities for women to receive even bachelor's degrees, the supply of candidates for the initial faculty positions at Wellesley College was indeed limited. Maria Eaton was the College's first professor of chemistry and served from 1876 to 1886. While according to Palmieri[29] no information is available about her, we have determined from a questionnaire Ms. Eaton filled out for Radcliffe College that she had studied at one time (probably prior to teaching at Wellesley) at the Framingham Normal School and at the Zurich Polytechnikum. After leaving Wellesley in 1886 she attended Radcliffe as a special student, taking courses in mathematics and physics.[30] Hackett[31] mentions another early teacher, Bessie T. Capen, but nothing else is known about her.

One or both of these initial Chemistry Department members must have taught Charlotte Fitch Roberts of the class of 1880, who joined Wellesley's faculty in 1881 at age 22 and served the

College for 36 years. (See Faculty Timeline, Figure 3) In addition to Ms. Roberts, during the years up to 1890 there were three other members of the staff, including one "assistant in Chemistry Laboratories" and two Instructors. In the early 1890's Associate Professor Roberts went off to Yale to complete her Ph.D., and was replaced in Analytical Chemistry by a male teacher (albeit on a temporary basis), Dr. Augustus Gill of M.I.T.[32] Ms. Roberts was one of the first two women to receive a Ph.D. from Yale. She specialized in stereochemistry, and published a book on that subject.

Beginning in 1890 the other senior faculty member in the Chemistry Department was Charlotte Almira Bragg, who received her B.S. from M.I.T. that year but never earned a higher degree and was not active in research.[33] Professor Bragg taught at Wellesley for 39 years (see Faculty Timeline, Figure 3). Helen S. French, her former student and eventual colleague, described Professor Bragg at the time of her retirement in 1929 as an intellectually rigorous and devoted teacher and mentor. [34]

Curriculum and Instruction in the Chemistry Department

What was taught in Chemistry courses in the 1870's? In his Harper's Magazine article, Abbott observes that in the "chemical" department the "instruction in chemistry is confined almost exclusively to actual work in the laboratory….There is no committing of text-books to memory, no wasting of time in witnessing sensational experiments by the teacher. The students work out their own experiments."[35] The subject matter of General Chemistry in 1877-78 included

the laws of chemical combinations
the chemical nomenclature and formulae
the properties of the elements, and of their more important compounds
the practical uses of apparatus
the methods of analysis
the qualitative tests for the detection of the substances studied
the connection of Chemistry with other sciences.

From the commencement of the course to the end, the students received practical instruction in the Laboratory. Each student had her own desk, apparatus and reagents, and took examinations "to determine whether the purpose of each Laboratory experiment has been fully comprehended. An equation is required for each reaction." The students learned to use a limited array of equipment (other than glassware), including "the Spectroscope, and the Compound Microscope." They also were "required to present subjects in the classroom in the form of brief lectures, accompanied by experiments, and by blackboard illustrations." In her second year in Chemistry a student studied Stoichiometry, Quantitative Analysis and Organic Chemistry.[36]

It appears that while fine physical facilities were constructed, the chemicals to be studied were in such limited supply that special note of gifts and purchases of them were made in the reports of the President of the College. For example, in 1893 the study of the metallic elements in General Chemistry was enhanced by "a collection of ores and minerals contributed by students,"[37] while in 1894 the Chemistry Department requested "[t]he purchase of a number of organic chemicals in small quantity, to be used in the laboratory and lecture rooms as illustrative of the compounds thus treated of."[38]

The Early Students of Wellesley College and the Post-College Lives

Who were the students who chose to attend this new college? Higher education for women was frowned upon by many at that time for a variety of reasons, including being bad for women's health (particularly their reproductive health). Rossiter claims that "[the advocates of higher education for women] were not professing to open new careers to women, but they had expected that their higher education would produce better wives and mothers for the American republic."[39] Mr. Durant and the founders of other women's colleges, however, believed that women could contribute to their goal of bettering society in other ways, particularly with respect to providing education for young people. Of course, in 1875 and for many years thereafter, the women who attended college and became professionals could only continue in their professions as long as they were not married. Marriage and career were not considered to be compatible. Thus, for example, Alice Freeman, the young President of Wellesley College appointed in 1881, felt she had to resign when she married Herbert Palmer at the end of 1887, although she remained on Wellesley's Board of Trustees until her death in 1902.[40] The low marriage rates and number of children of the early Wellesley graduates led to one of the early 20th century national criticisms of Wellesley and other women's colleges, that of causing "race suicide" by limiting the number of offspring produced by intelligent, college-educated women.[41]

In the College's first year only 30 of the 314 students admitted were found to be qualified to take the college course. According to Edward Abbott

> students present themselves with such irregular and imperfect preparation. They come from all parts of the country—from Maine to Texas, and from Georgia to Colorado—trained in differing studies by different methods, from all grades of private and public schools. It has been impossible to arrange all of them at once into regular and fully graded classes. Hence has arisen the necessity of a preparatory department alongside of the college proper. [42]

Student preparation improved rapidly, however, and President Alice Freeman was able to eliminate the college preparatory division in 1881. She encouraged the founding of good high schools for girls throughout the United States.[43] Furthermore, and significantly for the teaching of chemistry for the next century, the College almost immediately admitted graduate students. "As early as 1876 the Calendar announced that 'graduates of this and other colleges who desire to pursue their studies will be received'" [44] and in 1888, for example, there were two M.S. students in the Chemistry Department.

In 1888 the Chemistry Department awarded a total of 28 degrees, including eight 5-year B.A.'s, two 5-year B.S.'s, and eighteen 4-year B.A./B.S. degrees. By 1892 there were 734 graduates of Wellesley College, 540 of whom were teachers, 12 physicians, 15 librarians and 20 missionaries. By 1898 there were 1600 B.A. level graduates (average of about 150/year), and 583 students had enrolled in Wellesley's post-baccalaureate programs (many of them were "teacher specials" who could take any courses they wished), with a total of 57 M.A.'s awarded. [45]

1894-1935: The "Chemistry Building" Era

- World and national events during the next forty year period that had an obvious impact on Wellesley's Chemistry Department include the "Great War," World War I, which lasted from 1914 until 1918 (although the U.S.'s involvement was only for the final year of the war). In addition, the changing expectations for women that followed the war, as well as the economic Depression that began with the crash of the stock market in 1929, had a serious impact on Wellesley College students and faculty.

- Although by the end of the nineteenth century "professional scientists began to staff the universities, and private research institutions became more favorably disposed to research in pure science"[46] most "academic scientists remained suspicious of federal support for science well into the 1930's."[47] Thus, colleges like Wellesley remained dependent on internal funds or private gifts for the support of science education and research.

- In 1906 Congress passed the Food and Drug Act, opening career possibilities (but rarely for women) based on the study of organic chemistry as well as food analysis and bacteriology.[48] (Wellesley began teaching Air, Water and Food Analysis in 1901.) Wellesley was no longer a rarity in emphasizing laboratory work, as by the beginning of the 20th century, "virtually all chemistry courses included laboratory work."[49]

- The early Wellesley students were pioneers, serious about their academic purpose and expecting to follow college with a career, usually in teaching. Between 1900 and 1920, however, it became "fashionable" for young women to attend college, and many no longer wanted to sacrifice a social life and marriage to a career. As mentioned previously, low marriage rates for college-educated women sparked a national debate, of which Wellesley became the focus in 1915.[50]

The Place of Science in the College Curriculum

Wellesley College's original emphasis on math and science, instituted by Mr. Durant, was to last less than twenty years. In 1893 the faculty discontinued the separate General and Scientific Courses, and began to offer only a B.A. degree. Degree requirements came to include a combination of prescribed work, free electives, and restricted electives.[51] The distribution requirements adopted by Academic Council in 1893-94, shown below, remained in effect, with slight modifications, until 1932, and bear a strong resemblance to those of today.

In addition to these distribution requirements, to earn a B.A. degree a student had to complete a "concentration," or major, and during the 1920's a new emphasis was placed on "Honors in Subjects." A review by the College in 1927-28 of the success of the Honors program suggested that it had been very successful, with most of the Honors students going on to graduate work and winning distinction in their graduate schools.[52]

Distribution Requirements, in which a typical two-semester course counted as 3 hours: [53]

Biblical History	4.5 hours
English Composition	3 hours
Hygiene	2 hours
Philosophy and Psychology	3 hours
Reading and Speaking	1 hour
Mathematics (unless 4 entrance units are presented to constitute a satisfactory equivalent)	3 hours
A foreign language (unless satisfactory evidence of a knowledge of a third language is presented for admission)	3 hours
A biological science (unless 2 years of satisfactory biological science or sciences are offered for admission)	3 hours
A physical science (unless 2 years of satisfactory physical science or sciences are offered for admission)	3 hours

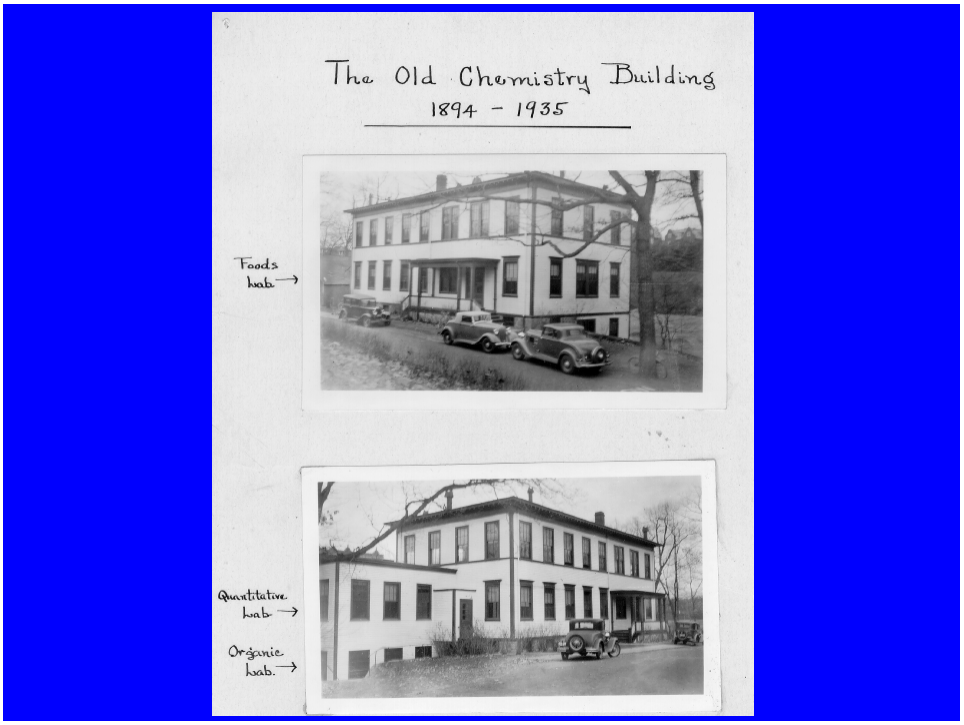
The Physical Facilities of the Chemistry Department

The Chemistry Department's facilities began to be a perpetual subject of complaint. In an interesting pattern of self-effacement that continued for many years, the Chemistry Department tended to focus on its limitations rather than its accomplishments in its reports to the President of the College.[54] At times the complaints yielded results, such as in 1894:

> The need of separate quarters for work in Chemistry has long been pressing, and at the adjourned meeting of the Board of Trustees, June, 1894, it was decided to put up a plain wooden building for the exclusive use of the department. The new laboratories were opened to students in February, 1895. The building proves excellently adapted to its purpose. It has two stories and a basement almost spacious enough to be counted as another story.[55]

The new building (Figure 4) contained large lecture rooms, prep rooms, a dark room, a library, a "teachers' laboratory," "rooms for work in Quantitative Analysis and Organic Chemistry" and "[a] large laboratory for General Chemistry with lockers for 200 students, and two adjacent rooms for Qualitative Analysis with accommodations for 42 students." Equipment in the labs included "draught cupboards for the manipulation of noxious gases, steam-drying oven, and filter pumps for quick filtering."

Figure 4



By 1908 and 1909 this "temporary" structure was already being described as inadequate, due to the addition of new laboratory courses and the increase in enrollments in Organic Chemistry.[56] Its replacement was to be far in the future, however, at least in part because of the tragedy of March 17, 1914 when College Hall, the heart of Wellesley College, burned to the ground. Palmieri describes the cause of the fire, taking speculation by Katherine C. Balderston, in her chapter "The Great Fire,"[57] and weaving them into an assertion:

> By common consensus the community claimed that the cause of the fire was unknown, even though it was general knowledge that Professor Maria Hubbard's incubator for beetles had started it with an electrical fire. But because Hubbard was depressed over the loss of twenty years of research, her friends were eager to absolve her of the blame.[58]

As a result of the fire, the Chemistry Department began to share its quarters with Physics leading to even more crowded facilities in the "temporary" Chemistry building. The dire situation that resulted was described in the Wellesley Alumnae Quarterly in 1920: "Experts declare that it is almost criminal to keep on with so many students in a wooden building. There is urgent need of a distilling room for such inflammables as ether and benzine [sic], constantly used in the work and for a separate room for poisonous gases, now used under poorly ventilated hoods."[59] Helen French lamented in her 1926 Annual Report, that "[I]n this present age, marked by the world-wide development of Physical Chemistry we are utterly unable to develop a laboratory course in the subject. The only room available is 9 x 11 feet, with no heat of any kind (and no water) so that it is useless in winter."

While the College was not ready to build a new building for Chemistry yet, the 1926 annual budget did provide funds for the department to purchase a large electric fan to ventilate the organic chemistry hoods, and an electric water still, and a Nutting photometer. At around the

same time the department acquired a polariscope, and Dubosc colorimeter, and a new balance. Ms. French noted that

> [W]ith the constant deviation spectrometer which the Physics Department purchased at the same time and allows us to use, we have therefore (kept at the Physics Building safe from chemical fumes) [sic] as good equipment as exists anywhere for research in absorption spectra in the visible region. [60]

Gifts began to come into the Chemistry Department in the early years of the 20th century, although they were few in number and limited in size. A few examples will illustrate their nature and extent. In 1903, according to the Annual Report of the College[61] gifts of dye-stuffs to the Chemistry Department completed a "good collection of specimens of organic compounds to use for instruction." In 1906 "The work in Chemistry [has been] given an added interest through the kindness of Mr. Wood, owner of the neighboring paint works, who offered two prizes of twenty-five dollars each for the best blue pigment produced by students."[62] In 1914-15 a Sartorius analytical balance was donated by a former president of M.I.T., James M. Crafts, known also for the Friedel-Crafts reaction.[63] Department chair Helen French reported to President Pendleton in 1926 that Miss Bragg "herself" had given "the department the necessary equipment for a satisfactory supply for hydrogen sulphide for the work in qualitative analysis." In addition, fathers of two students sent gifts of organic and inorganic chemicals from companies they represented.[64]

The Faculty of the Chemistry Department

For the first few years of this period, the faculty of the Chemistry Department continued to consist of Professors Roberts and Bragg, and one or two Instructors. A mainstay in the department for many years was Mary Maria Fuller, the "Assistant" in Chemistry Laboratories. It is not clear whether she was in charge of prepping labs or taught labs herself. (In the 1908-09 "Calendar" she began to be listed as Curator of Chemistry Laboratories.) Helen Somersby French, B.A. Wellesley 1907, joined the department as Assistant in Chemistry in 1907. Ms. French exemplified the mentor-disciple relationships both Palmieri[65] and Rossiter[66] have described as a tradition in the women's colleges, with one generation succeeding another on the faculty. By 1910 she had earned an M.A. at Wellesley and had become an Instructor. In 1920 the Wellesley Alumnae Quarterly[67] reported that Ms. French "took her Ph.D. degree under Professor Werner at Zurich in the year [1913] in which he won the Nobel prize for the most distinguished work in chemistry." Helen French continued to teach in the department until she retired in 1950. Another associate professor, Miss [Mary Amerman] Griggs, had been an analytical chemist in Lederle Laboratory in New York, and before coming to Wellesley had taught chemistry both at Vassar and at Columbia.[68]

In 1920-21 the faculty consisted of Professor Bragg and Associate Professors French and Griggs, one Instructor with an M.A. degree appointed for a single semester, and three Assistants, each of whom had a B.S. or B.A. degree. The Assistants were involved in most of the 100- and 200-level courses, and probably assisted in teaching the laboratories.[69] The faculty ranks increased in 1923-24 when Ruth Johnstin (Ph.D. Ohio State University 1926) joined the College. She had taught previously at Missouri Christian College and Milwaukee Downer College, and had worked for the U.S.D.A. as a Specialist in Food Chemistry. In 1925-26 Helen Thayer Jones, Ph.D., M.I.T. became an Instructor. In 1929-30 Emily May Hopkins, who was to serve the Chemistry Department in a support position for forty years, joined the department as "Custodian." She earned an M.A. degree a few years later. With Ms. Bragg's retirement in 1930, and from that time forward, the faculty in the professorial ranks all had the

Ph.D. During the 1930's in most years there were five faculty and 2 to 4 Laboratory Assistants, who held either B.A. or M.A. degrees.

Curriculum and Instruction in the Chemistry Department

In the years between 1895 and 1927 the Chemistry Department offered from 7 to 11 courses, and between 1927 and 1935 from 13 to 15 courses, some of which were semester courses and some year courses.[70] In 1896, for example, the Calendar listed

General Chemistry (one course)
Qualitative Analysis (two courses)
Quantitative Analysis (two courses)
Organic Chemistry (two courses, including an advanced course with laboratory work in organic preparation),
Theoretical Chemistry (one course)
Stereochemistry and Thermal Chemistry (one course -- withdrawn that year).

By 1920-21 an Elementary Chemistry course had been added "for beginners in Chemistry," and those in Theoretical Chemistry and Stereochemistry and Thermal Chemistry were gone. "Applied" courses appeared from time to time, such as "Chemistry and its Application to Daily Living," and "Chemistry in its Application to Other Sciences" in 1917. In 1919 Inorganic Chemistry and Physiological Chemistry were added, with the latter disappearing and then reappearing in 1926. In 1930 a Seminar on newer developments in chemistry was offered for the first time.

In 1934-35, as the department was preparing to move to new quarters in Pendleton Hall, the Chemistry major consisted of 5 specified courses plus electives. Majors were advised, not required to take one year of Physics, and acquire a reading knowledge of French and German, and [only] those intending to go on to graduate work in Chemistry were advised to complete at least one year of college Mathematics, with some work in Calculus. Students were offered the opportunity for extracurricular activities in Chemistry, such as lectures sponsored by the Science Club during World War I on the "Chemistry of Fasting," the "Pure Food Laws," and "The Nature of the Chemical Elements." Almost all of the courses in the Chemistry Department continued to have laboratories associated with them.

Laboratory Instruction

Who taught the laboratories associated with virtually every course, and under what conditions, is not entirely clear. Each year during this period the Wellesley College Calendar listed a number of "Assistants" as part of the faculty. Since these Assistants also produced M.A. theses (at least during the 1930's), some of the laboratory teaching must have been done by the women who were candidates for the M.A. degree. There is no record of how many laboratory sections they taught, or what the other conditions were of their study and work at the College, except for a brief reference in the1921-22 Annual Report of the Department which stated that Assistants obtain their Master's degree in 2-3 years, and that complementing their work with work in Boston is a "waste of time."[71] Over the century-long history of the Master's program in Chemistry, the students came from many different colleges and universities. The highest number came from Wellesley (21), followed by Mt. Holyoke and Milwaukee-Downer (each with 5), Georgia State College for Women (3) and Wheaton, Women's College of North Carolina, Randolph-Macon, Connecticut College and Regis College (each with 2). The other students

came from eighteen other schools, ranging from Oberlin to, in later years, Kyoto University and Cheng Kung University.

By the 1930's department chairs were beginning to express concern about relying on graduate students for teaching. In 1931-32, facing increasing enrollments in laboratory courses over a five year period, the chair stated: "The greatest academic need of the department is in the further replacement of inexperienced assistants in laboratory instruction by more experienced instructors." The same sentiment was echoed in 1933-34.[72]

The Impact of World War I

As soon as the United States entered the "great war" (World War I), Wellesley, along with other colleges for women, adopted a plan of mobilization. "The objects of the plan were to increase the personal efficiency of all members of the College through rigorously hygienic living; to eliminate waste through economy in dress, food and the use of time, and through co-operation in community responsibilities; to accelerate relief work through the organization of definite branches of service." The College also established nine "war emergency courses," including a course in "Household Economics, given by Mrs. Hilliard, formerly Associate Professor of Household Economics at Simmons College, a course of lectures and demonstrations with one year of chemistry prerequisite."[73]

The curriculum of the Chemistry Department was directly affected by the shortage of organic chemicals from Germany, which caused the faculty to modify Advanced Organic Chemistry in 1917-18. The American Chemical Society had ascertained what chemicals were needed nationwide and had begun to farm out the synthesis of these necessary chemicals to colleges and universities. Wellesley's advanced organic chemistry laboratory students worked on four of these problems, solving two of them successfully in the first year. Wellesley was commissioned to make a pound of metanitrobenzaldehyde (at a mere $15/lb) and a full-time assistant was expected to work on this project the following year.[74]

Changing career opportunities for women, caused to some extent by World War I, seem to have affected enrollments in Chemistry. In 1915-16 Professor Roberts reported to President Pendleton that 34 students had elected Organic Chemistry for the coming year, up from 15 the year before. She speculated: "This may be due to the fact that each year we find more and more students who are studying Chemistry as an adjunct to the study of Medicine."[75] Because of an increase in student enrollments, the Chemistry Department found itself "obliged" to ask Physics to give back one of the rooms they had been using. By 1916-17 the department was experiencing the "difficulties of getting supplies," at the same time as it was experiencing overcrowded laboratories while still sharing space with "the equally unfortunate Department of Physics."[76] Chemistry enrollments increased further during 1918-19, probably in response to the wartime conditions. As soon as the war was over enrollments decreased.

Faculty/Student Research in Chemistry

In the early twentieth century, faculty-student research was largely the domain of graduate students. By 1910 research publications by faculty and graduate students began to appear. Records from the Wellesley College Archives of theses produced by M.A. students were used to prepare Figure 5. It is highly likely that there were M.A. theses before this time, and that the number represented is the minimum number produced.

The level and importance of research activity and productivity of Wellesley faculty during this period is open to debate. Palmieri asserts that Wellesley faculty created a "self-imposed ceiling on [scholarly] achievement." Quoting Rossiter, she makes the judgment that "[R]ecognizing that they could not and would not go further, many academic women settled into lives and careers that were only moderately productive."[77] In fact, as we shall see, every generation of Chemistry Department faculty included at least one member who was a publishing scholar. (In the 1980's, expectations for faculty scholarship increased dramatically and the number of active scholars increased accordingly.) In 1924-26, for example, both Helen S. French and Mary A. Griggs published their research in journals such as Proceedings of the Royal Society, Journal of the Chemical Society, Journal of Industrial and Engineering Chemistry and Journal of Chemical Education. Ms. French's work was on absorption spectra of some inorganic coordination compounds and some organic molecules, focusing on "valency", and "types of conjugation." Ms. Griggs worked on reactions of casein and pectin. Ms. Griggs' co-authors were another Wellesley faculty member, Ruth Johnstin and a graduate student.[78] Professors French, Griggs and Johnstin continued to publish during their careers at Wellesley, sometimes with graduate students and occasionally with undergraduate co-authors.

Undergraduate student-faculty research in Chemistry was conducted primarily under the Honors program. The first Honors student reported by the Chemistry Department graduated in 1925, and presented a thesis entitled "Hydrogen Concentration of Certain Pectin Solutions," under the direction of Ms. Griggs. Figure 5 shows the number of Chemistry honors theses of which we are aware from that time forward. In 1929-30 another opportunity for student research appeared in a course that looks very similar to a current course:

> Individual Problems Each student electing this work will undertake an individual problem under the direction of the members of the teaching staff of the Chemistry department in whose field the student's chosen problem falls. The work will include both laboratory work and reading.

The Post-College Lives of Wellesley Chemistry Majors

The world of science experienced by Wellesley graduates of this era is illustrated by two alumna stories. A letter to the Wellesley Alumnae Magazine in 1977 from Frances Pettee Zoetmulder '18 gives us some insight into Ms. Zoetmulder's employment as a recent graduate during the remaining days of World War I. [79] In this letter she described a book she had written as

> a unique accounting of a woman's experience in a technical world – a man's world – in those days as World War I was dragging toward the 1918 Armistice. Recommended by the Wellesley Placement Bureau, with backing from Miss Charlotte Bragg, head of chemistry in those days, and Dr. Helen French, I was one of the first to be employed in a factory as first assistant chemist. The owners believed a woman chemist could work on the repetitive testing of its new chemical and physical research with no future problems of a professional nature. A woman's college graduate in those days did not compete with a graduate of MIT, for example …. Women's liberation was not the background for the unnoticed struggle which kept me in that company for 27 years. The laboratory work shifted to 'unbelievable,' with lively and significant developments.

Personal reflections on being a student in the Chemistry Department during the late 1920's come from Leslie Hudson Meyer, '29, whom we interviewed during her 70th Wellesley reunion in June 1999. Leslie Hudson transferred to Wellesley as a sophomore from her hometown college, Blackburn College in Carlinville IL, of which her father was president. Although as a

child she had "gone into the kitchen and mixed soda and vinegar and thought she was a chemist," she did not study chemistry in high school. Beginning her Wellesley chemistry studies with Qualitative and Quantitative Analysis (taught by Miss Griggs) as a sophomore, Mrs. Meyer found a mentor in Helen French. Mrs. Meyer considered Ms. French her "friend," remembering that she had brought in sandwiches and coffee during the dreaded General Examination. Mrs. Meyer had few memories of her lab experiences at Wellesley other than that she was careless and broke a lot of glassware. It was her own idea to get a Master's degree, she said, because her Wellesley mentor's position was "it won't do us any good—you'll just get married." At the University of Chicago Leslie Hudson was one of a few women graduate students, some working toward M.A.s and others toward Ph.D.s. Because there had been no laboratory with the Physical Chemistry course at Wellesley, she had to take an undergraduate course at Chicago. She wrote her Master's thesis on the formation of conjugated double bonds by the addition of hypochlorous or hypobromous acid to vinylacrylic acid. And, as predicted, she met her husband Al at Chicago where he was a lab assistant. She later moved with him to Wilmington, Delaware where he worked for DuPont, to Milwaukee, and finally to New Jersey, where she still lives. Leslie and Al had four children, the last one born in 1940. And although she always had a full-time maid, it "never entered her head to go to work."

Although Leslie Hudson Meyer did not pursue a career after Wellesley, by 1920 many alumnae of the Chemistry Department were holding positions in other colleges such as Mt. Holyoke, Yale, Cornell, Columbia, Milwaukee Downer and Constantinople College, including one assistant professorship at Barnard and one professorship at Connecticut College. Others had gone into medical or industrial research in companies such as General Electric, or into government service, one as city chemist in Rochester, N.Y., "at a salary far greater than her former instructors at Wellesley."[80]

1936-75: The Pendleton Hall Era

- The world became increasingly interconnected, and the role of the United States in world events grew dramatically during this period. Thus, it is difficult to select just a few local, national and world events that significantly affected the Chemistry Department at Wellesley College. However, the department was undoubtedly affected by World War II and its social and technological aftermath, the launch of Sputnik by the Soviet Union in 1957, the civil rights movement, the women's movement, and the U.S. involvement in the war in Viet Nam.

- It was during this period, particularly after 1945, that science policy and the support for science by the government and other foundations underwent revolutionary changes. According to Bruce Smith, in "American Science Policy Since World War II," while "most of the pieces that make up today's research system were in place" before World War I, the leaders of science continued to resist government support, fearing interference with the freedom of scientific inquiry.[81] However, the Depression of the 1930's brought hard times to colleges and universities, causing a split among the ranks of the scientific leadership with respect to government support.[82] Government agencies for science (the National Research Council of the National Academy of Sciences, NIH, NCI) already existed or were created during this period. By the end of the Depression, the Works Progress Administration "routinely awarded research contracts to universities."[83]

  Vannevar Bush, formerly of M.I.T., led the Office of Science Research and Development in the White House during World War II. According to Smith, Bush believed that an agency independent of the White House should be established, one that could operate more flexibly.[84] A consensus emerged after World War II that the government would have to

assume responsibility for nurturing basic scientific research. In 1945 a report entitled "Science—the Endless Frontier" was presented to President Harry S. Truman. This report, which emphasized the importance of basic research, argued not just for "big" science, but also that institutions with smaller programs should be supported.[85] Thus the National Science Foundation was born in 1948, but not without the setback of a Presidential veto of the original 1947 proposal, supposedly because no official responsible to the President would have been involved.[86]

Federal support for research and development grew 14% annually in constant dollars between 1953 and 1961. In addition, "[T]he 1957 Sputnik launches ensured increased R&D spending for a decade afterwards."[87] Following this first golden age of science, however, societal trends with negative impacts on government support of science emerged during the next decade. Smith describes the struggles of those responsible for science policy in the face of one of them:

> Intellectual ferment in the colleges and universities during the late 1960's raised nettlesome issues for scientists. Anti-elitism, minority [and women's] access to careers, the rights of human subjects in research and the public's right to hold private centers of power and privilege accountable were cherished notions of liberal champions of social reform. But when directed against the universities themselves, reformist ideas had worrisome consequences.[88]

And while Sputnik had launched tremendous and important support for training and research in science, by the late 1960's science and engineering Ph.D.'s began to flood the labor market.[89]

- The professionalization of chemists reached maturity during this period. In response to this, in 1936 the American Chemical Society began to study "the complex problems of determining standards and devising means for evaluating professional training in chemistry at the bachelor's level."[90] In addition, the study and practice of chemistry in the years after World War II saw the introduction of technology that was the direct result of wartime research and development. "New techniques such as gas chromatography, colorimetry, and ultraviolet, infrared, NMR, and microwave spectroscopy appeared in the laboratories. Advanced mathematical tools made calculus not only a requirement, but a fundamental part of chemical education."[91]

- Women's lives, their opportunities and expectations, changed dramatically throughout this period. As we shall see, World War II gave women unprecedented employment opportunities. But when the veterans of the war returned home and flooded the labor market, women were expected to return to their homes and devote themselves to raising families, perhaps to an even greater extent than during the preceding decades. During the 1960's this trend began to reverse itself, as women's "consciousness" began to be raised through books, articles, and discussion groups. The "women's movement" increased in strength during the late 1960's and early 1970's, and, along with the civil rights movement, changed this nation dramatically. Among other results of the women's movement was a breakdown of the expectation that women could have a career OR a family, but not both.

The Place of Science in the Wellesley College Curriculum

Students in Wellesley College classes between 1936 and 1965 encountered a curriculum, voted in 1932, that had undergone significant changes since the first half-century of the

college's existence. The degree requirements de-emphasized science even further, and took the form (if not the exact content) which remained in effect until very recently. Each student was required to elect at least 6 "year-hours" (4 one-semester courses at that time) from "each of 3 broad curricular areas:

- Group I, the arts, languages, and literature
- Group II, the social sciences, history, Biblical history, philosophy and psychology
- Group III, mathematics and the sciences.[92] (Between 1945 and 1965 psychology was included in Group III.[93])

In addition, students were required to take

- 3 year-hours in Biblical history (i.e. one two-semester course)
- 3 year-hours in English composition
- 1 year-hour each in hygiene, speech and physical education.

Finally, the language requirement could be satisfied by demonstrating a "reading knowledge, tested by examination, of a modern foreign language." Work for the major included 12 to 15 year-hours in a department (8-10 courses), with related work in other departments of 9 to 6 year-hours (4.5 to 3 courses).[94]

The decade of the 1960's was one of major transitions for Wellesley College, as it was for so many colleges and universities throughout the United States. Through the early 1960's the College maintained the norms established following World War II in social regulations, degree requirements, the calendar, and the makeup of the student body. But in the mid-1960's change began to occur in all of these dimensions. During a three-year period (1965-68) a major, albeit short-lived, change in the calendar of instruction was instituted by the faculty, with two longer terms and one shorter term offered each year. By 1968 this experimental calendar was dropped, and the College returned to a two-semester calendar, at least partly to accommodate a course exchange with M.I.T., officially inaugurated in 1968-69.[95] The year 1968 saw several revolutionary curricular changes, including the end of the requirement in Biblical History. This change, still lamented by alumnae of previous generations, eliminated all traces of one of Henry Fowle Durant's major passions. Also dropped were the requirement in English composition (reinstituted as the Writing Requirement), and the General Examination in the major field. The number of units required for the degree decreased from 40 to 32, and the number of units (one-semester courses) in each of the three distribution areas (renamed as A, B and C) was decreased to three, further de-emphasizing science and math.

The importance of science at the College was, however, emphasized from time to time with major conferences organized by the faculty. As reported in the New York Times on October 26, 1940, Professor Ruth Johnstin led a committee that organized a three-day conference on "Science and the Nation's Food." The conference was designed to "acquaint undergraduates with all phases of the problems concerned with food" world-wide, including "food production, food conservation, …."[96] At the time of the 75th anniversary in 1949, a "Science Conference on Energy," was held on March 17, an auspicious date, since it was on that date in 1870 that the original charter of the college was signed, and in 1914 that College Hall was destroyed by fire. Ms. Griggs chaired the conference, and invited speakers included Gerty T. Cori, Research Professor of Biochemistry at Washington University School of Medicine, co-winner with her husband of the 1947 Nobel Prize in physiology and medicine.[97] The next Science Symposium at the College, in 1963, entitled "The Scope of Science" again brought eminent scientists to campus for two days of lectures and panel discussions. [Among the nine visitors only one, Margaret Burbridge, an astronomer, was a woman, whereas in 1949 two women were included among the six scientists.][98]

The Physical Facilities of the Chemistry Department

The physical facilities of the Chemistry Department changed dramatically during the 1930s. While as early as 1900 Annual Reports of the College advocated the construction of a "Science Building," it took until 1931 for Sage Hall (Zoology, Botany and Bacteriology, Geology and Geography) and until 1936 for Pendleton Hall (Chemistry, Physics and Psychology) to be completed. The Chair of the Chemistry Department, Mary A. Griggs, wrote in her 1935-36 Annual Report:

> Obviously the outstanding event of the year for the Department of Chemistry has been its new building. Pendleton Hall, so far as the needs of the department are concerned, has proven to be completely satisfactory in every respect, from its great name down to its smallest working detail. The general requirements which were of the utmost importance have been realized, that is: the building is waterproof, the lighting is abundant, and the ventilating system works splendidly…It has entirely adequate facilities for the work of the department, both for class and individual study.[99]

In Pendleton West, Chemistry's new home (Figure 6a), the first floor held the departmental library, named in honor of Charlotte Fitch Roberts, 3 lecture rooms, the general chemistry laboratory, and faculty offices outfitted as research labs. On the ground floor were the labs for physical chemistry, food and physiological chemistry, and quantitative analysis and micro-analysis, the "quantitative" subjects.

Figure 6a

Pendleton Hall

The “more odorous experiments [we]re kept on the upper floor where the laboratories for organic, qualitative and inorganic chemistry [we]re now located” (Figure 6b). In addition, there were several smaller research or special purpose rooms, including

> a large funereal-looking, completely blackened room with photographic dark rooms on one side. Here various optical instruments can be set up. Wellesley boasts the possession of an Hilger ultra-violet polarimeter [purchased thanks to a gift of $1250 from an anonymous alumna] and quartz spectrograph, a Nutting photometer, a constant deviation wave-length spectrometer [funded partially by $400 from the Class of 1907 in honor of Professor Helen S. French], and a Pulfrich photometer [from the Class of 1906 in honor of Dr. Connie M. Guion ’06 – who is also responsible for our ongoing gifts from the Zimmermann Foundation], as well as several colorimeters and other more usual pieces of apparatus.[100]

Figure 6b

General Chemistry Laboratory, Pendleton, 1968

The Faculty of the Chemistry Department

Professors French, Griggs and Johnstin continued to teach during the first ten to fifteen years of this period. During the 1940's and 1950's they were joined by Margaret (Gretchen) Seikel, Philippa Gilchrist, Jean Crawford, Eleanor Webster and Elizabeth Jane Rock. (See Faculty Timeline, Figure 3) All of these chemists, most of them graduates of women's colleges, came to Wellesley with either industrial experience or teaching experience at other institutions. Eleanor Webster, Wellesley '42, continued the tradition of alumnae returning to teach. Elizabeth Rock was the department's first tenured physical chemist after Helen French. The size of the faculty continued to range from 7 to 8, with from 3 to 5 assistants. Throughout this period, members of the Chemistry Department participated in the program of college-supported sabbaticals, leaving Wellesley to conduct research at other institutions on a regular basis. While some male chemists joined the faculty from time to time, particularly during the 1960's, no male member of the faculty received tenure until the 1970's. Professors Crawford, Webster and Rock led the department during the 1960's. During this decade, when external grants became more available to college chemistry departments, the faculty applied for, and received, funding for significant amounts of equipment for instructional purposes and student-faculty research, for training of faculty and students, and for summer research opportunities for students.

Curriculum and Instruction in the Chemistry Department

Changes in high school preparation of Wellesley College students affected the introductory offerings of the Chemistry Department. In 1938-39, for example, Chemistry's Annual Report

noted that more students were entering college with a year of high school chemistry, causing a shift in the balance between the two introductory courses.[101] Most Wellesley students, particularly those who came to the College after Sputnik in 1957, had benefited from greatly improved high school science and math courses.

Requirements for the Chemistry major during the 1930's, 40's, and 50's remained relatively constant. Of particular note is that well into the 1950's math and physics courses were not required for the major, merely "advised," as was a reading knowledge of French and German. During the 1940's, for example, requirements included:

Elementary Chemistry, choice between two courses, depending on whether high school chemistry was presented (year course, with laboratory)
Qualitative Analysis (semester course with laboratory)
Quantitative Analysis (semester course with laboratory)
Organic Chemistry (year course with laboratory).

In addition, a chemistry major chose among electives, to bring the total number of semester courses to eight. Electives included laboratory courses in qualitative organic chemistry, advanced quantitative analysis, physical, theoretical, and advanced inorganic chemistry, chemistry of food and nutrition, biochemistry, and quantitative organic microanalysis.[102]

The establishment of the minimum standards for professional training of chemists by the American Chemical Society (ACS) in 1936 launched a "love-hate relationship" between Wellesley's Chemistry Department and that organization, which persists to this day. Except for a brief period in the early 1940's, Wellesley's Chemistry Department has always been on the ACS "approved list." The great consternation that accompanied being dropped from the list in 1944 provides a typical reflection of the impact of the ACS's expectations on this liberal arts college department. Following notification of loss of certification, Helen T. Jones, Chairman, wrote a petition for additional laboratory courses to Ella Keats Whiting, Chairman of Wellesley's Curriculum Committee (October 8, 1944):

> The department does not expect now to have many students who will meet the course requirements of the American Chemical Society, but the department and President McAfee are jealous of the reputation of Wellesley College in chemical circles, and would like to make it as easy as possible for a student to meet the requirements. At present Wellesley College is not on the Society's accredited list, while many of its sister colleges are and this is a source of real distress to all of us. A special section in Physical Chemistry with Calculus as a prerequisite is now being given to meet one criticism of the department and if we may offer these new laboratory courses we feel that we shall more nearly keep to the spirit of the liberal arts course in which we so strongly believe and yet not penalize the more chemically-ambitious of our majors.[103]

By 1964-65 a year each of physics and math were required for the chemistry major, and specified chemistry courses included 1 semester of quantitative analysis, 2 semesters of organic chemistry, and 2 semesters of physical chemistry. To make up the eight course major, inorganic chemistry was advised, plus electives. Advanced quantitative analysis had evolved into instrumental analysis. Chemistry majors in the 1960's were spending much less time in the laboratory than had majors in the previous 3 decades. This further exacerbated the difficulty of ACS accreditation for individual students, since even in prior years when more hours in the laboratory were included with each chemistry course most students fell short of the laboratory expectations of the ACS.

During World War II enrollments and numbers of majors in the Chemistry Department were higher than ever before (see Figures 7 and 8). However, this level of student interest in Chemistry declined right after the war, and did not again reach the World War II levels until the late 1970's. Perhaps this was a result of the decreased emphasis on science in Wellesley's distribution requirements that had continued since the mid-1930's. We might speculate that it took the feminist movement that began in the 1960's to bring about increased enrollments in Chemistry. Changing expectations for life styles that included careers as well as marriage and families, combined with increased opportunities for women in such fields as medicine, led to significant increases in enrollments. If we examine the number of majors, a similar trend is observed, especially following the introduction of the Molecular Biology (now called Biological Chemistry) major in 1966-67, with its first graduates in 1968. As can be seen in Figure 8, the number of majors (in Chemistry and Molecular Biology combined!) was lower in the late 1960's and early 1970's than at any previous time for which we have systematic data.

The content of courses and related laboratories changed dramatically beginning in the 1950's. Physical Chemistry and Biochemistry courses, with laboratory, became regular parts of the curriculum. Government agency-sponsored workshops for faculty, such as a workshop on nuclear chemistry and radioactivity attended by members of the department at the dawn of the 1960's, led to major modifications in courses, particularly at the introductory level. An Atomic Energy Commission grant enabled faculty in five science departments (physics, chemistry, geology, botany and bacteriology, and zoology and physiology [separate departments at the time – later merged into Biological Sciences] to purchase equipment and provide training for faculty.

As more electronic instruments became available during the 1960's, they were purchased with the help of grants from NSF to the Chemistry Department, as well as funds from the College. As recently as the 1960's most uv-visible spectra, for example, were collected point by point and plotted manually. The introduction of strip-chart recorders to instruments represented a major savings in effort. NMR spectrometers, based on a phenomenon first observed in 1945, became affordable by colleges such as Wellesley in the late 1960's. Wellesley's sophisticated scientific equipment was, according to an article in the Wellesley Alumnae Magazine, one of the features of the College that attracted students from other New England liberal arts colleges in the newly launched Twelve College Exchange.[104]

Laboratory Instruction

Laboratory teaching continued to be largely the responsibility of faculty, assisted to a decreasing extent by graduate students. The situation deteriorated steadily, with fewer and fewer graduate students enrolling at Wellesley. In 1956, for example, the department's Annual Report expressed the concern that the staff for teaching laboratories was scant, with only one instead of five graduate assistants. Letters had been sent to 140 colleges and universities and to 40 foreign universities, but they yielded only a couple of possibilities from the foreign schools. "Majors were pressed into service"[105] By 1958 graduate students from non-U.S. colleges were teaching the laboratories, and were found to be generally satisfactory. This situation continued into the early 1960's, when, once again, it became impossible to staff laboratories. In 1963-64, senior majors again taught laboratory sections.

Motivated largely by the need to find qualified people to teach laboratories, since the few foreign M.A. students available at the time had poor English skills and had learned chemistry under a very different system, the Wellesley College Institute in Chemistry (WCIIC), was launched in the

summer of 1964. The WCIIC, funded by NSF and directed by Eleanor R. Webster, functioned through the 1971-1972 academic year. The Institute "provided an opportunity for women who had completed work for a Bachelor's degree five or more years earlier to return for two years for part-time study at Wellesley leading to the degree of Master of Arts in Chemistry."[106] This program, unique for its time, included women "just old enough to have completed college five years before to one or two who had been away from their undergraduate studies for twenty-three to twenty-five years." NSF funds covered not only Wellesley tuition, but also transportation and baby-sitting expenses for those students with children, a highly innovative feature.

Between 1965 and 1969 thirty-four women completed at least one year of study at the WCIIC. Twenty-one received the M.A. degree. Some of these women went on to Ph.D. programs, some into industrial research or museum work, several to high school teaching, and others to junior college or college teaching. Every graduate student was required to teach a laboratory section during her second year in the program. The training afforded by the WCIIC brought about a significant change in the teaching of laboratories at Wellesley. Professional laboratory teaching positions were created, and were filled by two of the five graduates of the last years of the program (1970-72). In addition the laboratory teaching staff came to include two instructors who had earlier received Master's degrees from Wellesley and Brandeis.

Faculty/Student Research in Chemistry

Research in the Chemistry Department continued to result in publications into the 1940's and 1950's. Some of this work involved collaboration among members of the department, sometimes with scientists at other institutions (e.g. Ruth Johnstin's work in the late 1930's and early 1940's on the synthesis of pectinates of heavy metals and their applications to wound-healing, Ms. Griggs's work on spectrographic analysis of bone growth and lead poisoning). During the late 1930's faculty research was aided by assistants supported by the College.[107] In 1947, Helen S. French became Wellesley's first Research Professor of Chemistry, a position she held for three years prior to her retirement from the College. Throughout her long career, Professor French had used physical methods to study molecular structure, at that time on "the valence bonds of nickel in compounds where it is combined with other groups through two nitrogen and two oxygen atoms." She was particularly interested in the degree of strain in such rings.[108] Professor Seikel was a very active researcher, interested in the phenolic compounds in plant pigments and in lignin, a component of woody tissue, throughout her relatively short career at Wellesley. Probably knowing she was in failing health, she resigned in 1961 to pursue research full-time at the Unisted States Forest Products Laboratory in Madison Wisconsin.[109]

Faculty-student research entered a new era in 1962 with Wellesley's first grant from NSF for a summer research project. During that summer six students – two sophomores, two juniors and two seniors -- spent eight weeks working in pairs with three members of the Chemistry Department on their continuing research projects in analytical, organic and physical chemistry.[110] In opening the program to sophomores the department began a tradition that has continued to this day: introducing students to research **early** in their college careers. The program included a Journal Club and a research seminar at which faculty and students "pooled their knowledge to offer suggestions to anyone encountering experimental difficulties." The program's impact on participants was significant, with many continuing on to graduate study in science and to academic careers. Funding from the NSF for summer research programs continued through the 1960's. In addition, during two years of the 1960's the number of B.A. Honors Theses rose to 4 and 6 (see Figure 5), as compared with the usual number which had

fluctuated between 1 and 3 annually since the 1920's. While few of the Honors projects resulted in publications in refereed journals, some of them were presented by students at local chemistry conferences.

The Post-College Lives of Chemistry Majors[111]

The story of one of the graduates of Wellesley with B.A. in 1942 and an M.A. from the WCIIC in 1969 encapsulates the decades of the 1940's through 1960's. B. D., the only child of a chemical engineer and a homemaker, came to Wellesley in 1938 from Columbia H.S. in New Jersey. One of seven high school classmates who entered the College that year, B. D. knew she wanted to be an industrial chemist, even though "everyone laughed at her." She chose Wellesley because of the "beautiful new labs in Pendleton," and worked part of the time while in college polishing steam baths and prepping organic labs. As a chemistry major, she found the Chemistry Department "alive." Helen French, who became her mentor, had spent her sabbatical with Linus Pauling, who had just published "The Nature of the Chemical Bond" in 1938. Margaret Seikel, fresh from her work at M.I.T., was enthusiastic about her new qualitative organic course as well as her research on the color pigments in flowers. B. D. did not do research as an undergraduate and did not recall many of her classmates doing so either, although she reported spending a lot of time in the laboratory as part of her regular course work. She also recalled the department's lack of ACS accreditation, attributed to not enough math requirements.

In 1942 B. D., one of 38 (!) chemistry majors, was recruited by Hercules Powder, having interviewed with Dupont, Celanese, Lever Brothers and Armstrong Cork as well. As far as she knows, the spring of 1942 was the first time industrial recruiters came to Wellesley to interview prospective laboratory chemists:

> In many places those hired were the first women in their positions and found themselves with recent graduates from Smith and Holyoke feeling their way. … There were no role models either for bosses or employees. Lavatories and rest rooms were hastily arranged. You had to learn the company's culture and the chemistry of your particular job. Older hourly employees were not always helpful. (Men with long experience and lots of factual knowledge had to find out how to deal with women as bosses.) Pay, many found out, was not the same as for men in similar positions.

Of the 26 Chemistry majors in the Class of '42 about whom B. D. was able to gather information, five completed medical school, three eventually earned Master's and two Ph.D.'s in chemistry, one became a patent examiner, and 17 immediately took laboratory positions either in industrial or government labs. While a few of B. D.'s classmates continued working after World War II, most of them married, left paid employment, and raised families. B. D. herself married a farmer, raised 7 children, and found that when her children took high school chemistry she was appalled at the quality of their courses. She came back to Wellesley to the WCIIC and earned her M.A. in 1969. Among the changes she found in the department were: an entirely different faculty (although one of her classmates, Eleanor R. Webster, was one of them), calculators and a GE time-shared computer instead of a slide rule and logarithms, pH meters instead of titrations with indicators, ground glass equipment instead of cork stoppers, and no Saturday classes. B. D. taught chemistry at a high school near her home for 17 years before she retired. During those years she instituted an Advanced Placement Chemistry course and served as science department chair.

Employment opportunities for Wellesley chemistry majors underwent extreme fluctuations during the period from 1935 to 1974. The first major escalation in opportunities occurred during World War II, as just described in B. D.'s story. Following the post-war decline in opportunities, the Wellesley Alumnae Magazine reported in May 1952 that the recruiters were back. "Industrial concerns are soliciting the College with multiple calls, -- 'all you can send us.' Medical research directors are equally eager. Government projects are also open."[112] A similar report appeared in the March 1962 issue of the Alumnae Magazine. But by the late 1960's and early 1970's, a glut of scientists produced during the post-Sputnik era, combined with growing national disillusionment with science, decreased both employment opportunities and student interest in science.

In the late 1960's and early 1970's, when many formerly all-male colleges and universities voluntarily became coeducational, Wellesley, too, considered this option. Although there was significant student and faculty support for the change, the Trustees chose to maintain Wellesley's single sex status. At the same time, the College, in part due to student pressure, began to make efforts to increase the racial and ethnic diversity of the student body.

1976-2000: The Science Center Era

- For the last quarter-century we have been living in a time of ever-expanding dependence upon and opportunities (and challenges) created by advances in technology, particularly computer technology. Among the many results of these advances has been a revolution in communication and access to information. The globalization of research, development and commerce (not to mention politics) about which we often speak would not have been possible without these newly developed communication pathways. In addition, particularly during the last decade, this has been a time of unprecedented affluence, with its resulting impact on colleges such as Wellesley that depend upon the generosity of others.

- Government support for basic science, shaken during the Viet Nam War, was strengthened again. Between 1965 and 1984 federal obligations for plant, facilities and large equipment in colleges and universities, as well as graduate fellowships, were substantially reduced, affecting smaller and "developing" institutions more dramatically than the most highly ranked graduate Chemistry departments, for example.[113] However, by the 1980's high levels of federal support were re-established. Grants for faculty research, as well as student training and equipment, have become much more available during this period. Thanks to the work of such organizations as the Council for Undergraduate Research, both the NSF and NIH have created programs aimed at non-Ph.D. granting institutions.

- The state of the chemistry profession has depended heavily upon the influences just described. Although employment opportunities for chemists have increased, changes in corporate culture have affected the career paths of chemists involved in industrial research. While opportunities for women have become more abundant, no longer can anyone automatically expect to be employed at the same company throughout her/his career. The expansion of academic institutions that had created many faculty positions in the post-World War II period slowed, and during the 1980's many public college and university systems underwent major cutbacks. Furthermore, the lifting of the mandatory retirement age introduced an uncertainty into the formerly more predictable turnover in positions.

- The situation for women was epitomized at Wellesley's Commencement this past June. On that occasion, television journalist Lynn Sherr '63 felt that she had to remind the graduating

seniors that the wealth of opportunities they take for granted was not always there. She adjured them to remember the feminists who preceded them and not to be embarrassed to call themselves feminists. Indeed, faculty members teaching during the last 25 years have encountered a student body who come to college expecting to pursue careers after graduation, and who view their college years as preparatory for the rest of their working lives. While this attitude has been virtually universal among male college students for the past century, female students, as we have seen, have not always had such expectations.

The Place of Science in the Wellesley College Curriculum

The faculty of Wellesley College undertook a major curriculum review during the mid-1990's. Two changes in degree requirements have affected the place of science in the curriculum. The first of these was the introduction of a Quantitative Reasoning (QR) Requirement for all students beginning with the class of 2001. Students must pass a QR assessment administered during their first-year orientation, or take a course designed to strengthen their QR skills. Many of these skills had long been seen as necessary for success in introductory chemistry courses, but merely having taken even four years of high school mathematics did not always guarantee students' facility with them. In addition, all students must elect a course that includes probability and statistics. Every science department now offers at least one introductory course that includes such material, and there is a highly populated joint social sciences QR course offered each semester. The second change in degree requirements affecting the place of science was a reconceptualizing of the distribution requirements. In particular, all students must elect at least one science, math or computer science course that includes mathematical modeling and problem solving. Again, many chemistry courses fulfill this requirement.

The Physical Facilities of the Chemistry Department

In the mid-1970's all of Wellesley's science faculty moved together into the new Science Center (Figure 9a). As described by historian Helen Lefkowitz Horowitz "Wellesley's new Science Center claims instant attention because its post-Beauborg facade in glass and primary colors breaks sharply with its Gothic neighbors."[114] The 1977 Science Center added a new laboratory and library building to the existing Sage Hall (1927 and 1931). The four-story atrium that links the two buildings, complete with palm trees during its early years, echoes, perhaps unknowingly, the College Center of the original 1875 College Hall. In 1987 the Science Center won the Harleston Parker Medal of the Boston Society of Architects, one of the most prestigious awards in the nation, given for "the most beautiful piece of architecture, building, monument or structure within the limits of the City of Boston or the Metropolitan Parks District."

Figure 9a

The Science Center

Bringing together all of the natural and physical science departments, mathematics, computer science and psychology, Wellesley's Science Center has provided an environment in which incidental and planned interdepartmental interactions occur regularly. They occur daily in the mail room and the lounge as well as through the Science Center Chairs' Committee, or in courses taught jointly or in coordinated fashion by faculty from different science departments. Administrative functions for the Center and departments (with a few exceptions) are located in the atrium area, known as the Focus. Expanded in 1990 to accommodate growth in computer science and in faculty research, the Science Center now comprises 146,620 net square feet of space, including the Science Library, classrooms, teaching laboratories, and individual offices and 400 square foot research labs for each experimental scientist. The teaching laboratories, rather than being separated by walls, are separated by potentially moveable supports, cabinets and hoods. All of the furnishings are highly modular, with the potential for convenient rearrangement (Figure 9b).

Figure 9b

A Chemistry Laboratory in the Science Center

The Faculty of the Chemistry Department

The faculty of the Chemistry Department at Wellesley during the last 25 years has been very different from that of any preceding period in a number of ways. Although men had taught an occasional course in the department as early as the 1880's, no male had become a permanent part of the department until the early 1970's. Now the tenured faculty of the department is approximately evenly split among men and women. Most members of the department combine career, marriage and family, a lifestyle formerly denied to a great extent to Wellesley's [female] faculty. (One of only two tenured member of the Chemistry Department faculty who ever resigned was Judith Levy, who served the College from 1972-1986. Professor Levy resigned for family reasons, and became the Chair of the Chemistry Department at Eastern Michigan University.) She is now Dean of the Faculty at Ursinus College in Pennsylvania. The faculty are also much more racially and ethnically diverse than in former generations. A wide range of sub-specialties is represented, with tenured faculty in analytical, inorganic and biochemistry, as well as the historically represented organic and physical chemistry.

Another change among most faculty in Wellesley's Chemistry Department relates to prior experience. Wellesley almost always hires faculty at the Assistant Professor level and promotes them through the ranks. Thus, as we have seen in the Faculty Timeline, Figure 3, many faculty have served the College for many years. Most faculty hired into tenure-track positions in Chemistry at Wellesley during the last fifteen years have had post-doctoral experience, and all have received start-up funding from the College as well as the Dreyfus Foundation, ACS-Petroleum Research Fund and Research Corporation. Some senior faculty have brought postdoctoral fellows to their labs, funded by NSF, NIH or Dreyfus Foundation

grants. These fellows came to Wellesley with the eventual ambition of teaching at a liberal arts college, and most found high quality tenure-track positions.

Since Eben Horsford provided the earliest support for faculty sabbaticals, Wellesley has had a generous sabbatical leave policy, today one of the most generous among all liberal arts colleges. Faculty who do a "strenuous search" for outside funding, in the form of three applications to funding agencies, receive full salary for a full year of sabbatical every seventh year, or a full semester every seventh semester. The strenuous search has led Chemistry Department faculty to sabbatical support from NSF, the American Association of University Women, and the Guggenheim Foundation, among others.

Curriculum and Instruction in the Chemistry Department

Arguably, the major factor affecting curriculum and instruction in the Chemistry Department during the last 25 years as been the ever-expanding use of computers. Computers serve as teaching aids, allowing the demonstration of phenomena formerly taught with static pictures or laboriously-built physical models, and as computational tools for students. In addition, hands-on laboratory education in the Chemistry Department evolved during the last quarter-century, in terms of what is taught, how it is taught, and who teaches it. Several publications in the Journal of Chemical Education [get list of jce articles] during this period attest to the continuing attention in the department to providing a laboratory experience that is coherent and thought-provoking. Use of the "discovery method" in introductory labs has met with mixed success, but is likely to be continued and refined. Upper level labs often involve project-type experiments, several of which culminate in the preparation of a mock research proposal or publication-style papers. Thanks to the acquisition of a state-of-the-art NMR spectrometer, all organic chemistry students learn how to run spectra of their own "unknowns." This summer new experiments were developed for our modified biochemistry sequence, as well as for a new course in physical chemistry for biological chemistry majors.

Requirements for the chemistry major went through an interesting set of transitions during the last 25 years, until today the major is more extensively specified than at any time in the College's history. Requirements include courses with laboratory (3.5 hours/week) in

Introductory Chemistry (1 or 2 semesters depending in high school preparation)
Organic Chemistry (2 semesters)
Inorganic Chemistry (1 semester)
Analytical Chemistry (1 semester).
Physical Chemistry (2 semesters)
Biochemistry (1 semester)

The math requirement remains the same, but the physics requirement decreased to two introductory-level courses from the intermediate-level course required during the 1970's and 80's. Yet the number of hours in the laboratory is much lower than during earlier eras, continuing to present a challenge to ACS certification of individual students.

The Chemistry Department has been able to maintain a high level of instrumentation for its teaching and research program, again through both external and internal support. Many NSF ILI and other equipment grants have been matched by the College; three large Howard Hughes Medical Institute (HHMI) grants, as well as smaller grants from industry and the College's annual capital budget, have contributed to the excellence of the laboratory equipment. The recent evolution to a combination of actual experimentation and computer simulation has likewise been supported by the College through the complete networking of the campus and the equipping of high-technology classrooms and laboratories. This evolution remains an ongoing challenge, both philosophical and practical, for the faculty of the Chemistry Department. Will

the historical emphasis on hands-on laboratory education for Wellesley students give way to virtual science?

Laboratory Instruction

Finding suitable persons to teach in the laboratory has been an ongoing challenge for the Chemistry Department. Since 1975 more and more laboratory instruction has been in the hands of professional laboratory instructors, scientists with M.A., M.S. or, more recently, Ph.D. degrees in chemistry. Particularly since the change to the four-course load for faculty in the late 1980's, the role of these laboratory instructors has expanded. The corollary for the faculty is that the close relationships that resulted from spending 3.5 hours in the lab with a small group of students has been lost to a great extent, especially in introductory and organic chemistry in which faculty encounter the vast majority of students. The faculty face the challenge of maintaining the crucial correlation of laboratory and lecture in a setting in which the distance of the faculty from the labs has increased.

Faculty/Student Research in Chemistry

Although their demographics and training have changed, today's faculty carry on much of the tradition established at the very beginning of the College. This tradition emphasizes teaching, coupled with concern for each individual student's progress as a chemist and as a person. During the last 25 years this has come to include an expectation that students majoring in chemistry or biological chemistry participate in research, either with Wellesley faculty on-campus or off-campus with scientists at other academic institutions or industrial or government labs. While some colleges and universities include a requirement of independent work, or in some cases a thesis, for all students, Wellesley does not. The Chemistry Department, however, usually has the highest percentage of honors theses per major in the College.

Does this research expectation mirror an increased level of research activity among the faculty? During the 1980's, a group of 50 liberal arts colleges met at Oberlin College to discuss a variety of topics of common interest. One of the outcomes of this meetings was the term "research college." Always controversial, at least at Wellesley, the notion of a research college was consistent with the changing expectations for tenure. Faculty who joined the College during this 25 year period encountered a clearly expressed expectation for excellence in both teaching and research, as well as a demonstrated commitment of service to the institution. This increased emphasis on research was recognized by a change in 1988 in the normal teaching load for tenured and tenure-track faculty from five to four "units" per year. While the amount of external research funding has not become an important factor in tenure and promotion decisions, a clearly articulated scholarly agenda actualized in published work has. For scientists in Wellesley's Chemistry Department this has led to some tension. The importance of research with undergraduates is a universally held value. Encouraging students to present their work at local and national meetings is as well. However, bringing that research to fruition in the form of publication is less universally accepted.

Support for research with students in the Chemistry Department has been extensive, from sources both outside and within the College. The department has benefited from a series of NSF-REU grants for summer research programs, as well as funding for summer research from the HHMI and the Fairchild Foundation. The College has internal funds devoted to research in science thanks to the generosity of individual donors. New programs devoted to increasing the

participation of under-represented minority students in science have been enthusiastically welcomed by the Chemistry Department. The success of Chemistry (and Biological Sciences) in involving students in research led to Wellesley's recent NSF AIRE grant, which is enabling the College to extend its science student/faculty research model to the social sciences.

The Post-College Lives of Chemistry Majors

The Wellesley College student of today enters college planning to have a career. For the Chemistry Department, particular student career expectations that have affected enrollments and student behavior have included the large interest in medical school (each year 20-25% of entering first-year students express an interest in premedical studies), as well as a smaller number of students who desire an education in science for its own sake. The Chemistry Department teaches virtually all of the approximately 20% of Wellesley students who are pre-med for at least two years, as well as all of the non-pred-med Chemistry or Biological Chemistry majors for four years. (The number of students eventually applying to medical school is closer to 10-15% of a given class.)

In an attempt to understand the factors that enhance the retention of women in science, the Alfred P. Sloan Foundation funded the study "Pathways for Women in the Sciences," during the early to mid-1990's. "Pathways" examined Wellesley's Class of 1995 throughout the students' four years at the College, and a sample of alumnae from the Classes of 1968-82. Results of the Pathways study of the Class of 1995 made it very clear, first of all, that students who study science in college came to college interested in science. Very few college students stumble upon science and enter in the field. "The challenge of the undergraduate years is therefore an issue of retaining those who have already shown an interest in science and math."[115] Encouragement from multiple sources: parents, friends and faculty, were among the important factors helping retain students as science majors.[116]

When the Pathways survey data were collected in the mid-1990's, of the alumnae in the physical sciences (including chemistry) graduating between 1976 and 1983, each of whom would have had some experience in the Science Center, 18% were in academic careers 33% in engineering, and the other 49% in a government or industrial position. Forty-five percent of them worked in a laboratory.[117] Mentors and undergraduate research experiences were among the most important factors that had led these women to pursue a career in the sciences after graduation from Wellesley.[118] A commentary on the workplace situation was that while employment opportunities were plentiful, alumnae in the physical sciences were less likely than those in the life sciences, mathematics and computer science, business, medicine or law to say that "official organization policies are supportive of women, or that their work environment supports hiring and promotional opportunities for women."[119] Only 30% of co-workers at their own or higher levels in their organizations were women, as compared with 50-60% in the life sciences or mathematics and computer science.[120]

Conclusion

While Wellesley College's original emphasis on science for all students has decreased dramatically, relative to most of higher education the College's science emphasis has remained strong. It has been enhanced recently with the new QR requirement and increased specificity of the science requirement. In addition, institutional and external support for science has increased dramatically, enabling an active community of teacher-scholars and student scientists to study and work together in atmosphere of excitement and promise. Wellesley's Chemistry

Department absorbs, transmits and reflects the changes in the surrounding local, national, and increasingly global culture. Finally, the opportunities for a diversity of lifestyles and career paths for faculty and students have also increased steadily.

Acknowledgements

The genesis of this paper was an invitation to David Haines, Associate Professor of Chemistry at Wellesley College, to participate in a Symposium on Academic Chemistry Departments at the August 1999 meeting of the American Chemical Society in New Orleans. We are grateful to Professor Haines for passing along this opportunity to us. The Wellesley College Archives provided primary source materials such as annual reports of the chairs of the Chemistry Department, old College Bulletins, and photographs. Wilma Slaight and Jean Berry were of great assistance to us in the Archives, locating old documents and scanning old photographs into the computer. In addition, Eleanor Webster and Nancy Kolodny interviewed a number of Wellesley chemistry majors from the decades of the 1920s through 1940s. We also reviewed the various incarnations of *Wellesley* magazine (called the Wellesley Alumnae Magazine for much of its history) for articles about the Chemistry Department. Science Librarian Irene Laursen was of great assistance with a literature search on the history of laboratory education in chemistry that yielded another set of secondary sources, which, together with a number of books on women's education, provided the general background for this paper.

In the end, this work was not presented at the American Chemical Society meeting due to the death of the father of the presenting author. Stanley Harrison, Nancy Harrison Kolodny's father, passed away shortly before that meeting. We dedicate this paper to him, a man who encouraged his daughter's technical interests when she was a child, and who was always proud of "his daughter who went to Wellesley."

ENDNOTES

[1] Smith, Bruce L. R., *American Science Policy Since World War II*, (The Brookings Institution: Washington, D.C., 1990), 1.
[2] Ref. 1, 21.
[3] Rossiter, Margaret W., *Women Scientists in America: Struggles and Strategies to 1940*, (The Johns Hopkins University Press: Baltimore, MD, 1982), 78.
[4] Carroll, P. Thomas, *Academic Chemistry in America, 1876-1976: Diversification, Growth and Change*, (Ph.D. Thesis, University of Pennsylvania, 1982, University Microfilms International: Ann Arbor, MI), 26.
[5] Powers, quoted in Hale, Harrison, J. Chem. Educ. 9 (1932), 729-744.
[6] Lewenstein, Bruce V., J. Chem. Educ. 66 (1989), 37-44.
[7] Noyes, quoted in Hale, ref. 5.
[8] Palmieri, Patricia Ann, *In Adamless Eden: The Community of Women Faculty at Wellesley*, (Yale University Press: New Haven, 1995), 77.
[9] Rossiter, ref. 3, 9-10.
[10] Hackett, Alice Payne, *Wellesley: Part of the American Story*, (E.P. Dutton & Co., Inc. Publishers: New York, 1949).
[11] Palmieri, ref. 8, 77.
[12] Horowitz, Helen Lefkowitz, *Alma Mater: Design and Experience in the Women's Colleges from Their Nineteenth-Century Beginnings to the 1930s*, (Alfred A. Knopf: New York, 1984).
[13] Glasscock, Jean, Ed., *Wellesley College 1875-1975: A Century of Women*, (Wellesley College, Wellesley, MA, 1975).
[14] Horowitz, ref. 12, 42.
[15] Ref. 12, 45.
[16] Hackett, ref. 10, 43.
[17] Palmieri, ref. 8, 9.

[18] Browne, C.A., J. Chem. Educ. 9 (1932), 696-728.
[19] Hackett, ref. 10, 48.
[20] Palmieri, ref. 8, 9.
[21] Wellesley College Calendar, 1877-78, 33.
[22] Wellesley College Calendar, 1881-82, 18-19.
[23] Abbott, Edward, Harper's New Monthly Magazine 53 (1876) 321.
[24] Hackett, ref. 10, 50.
[25] Wellesley College Calendar, 1877-78, 36.
[26] Annual Report, Wellesley College, 1883, 8.
[27] Annual Report, Wellesley College, 1888, 10.
[28] Hale, ref. 5.
[29] Palmieri, ref. 8, 175.
[30] Radcliffe College Alumnae Information Questionnaires, 1928 and 1934.
[31] Hackett, ref. 10, 46.
[32] President's Report, Wellesley College, 1892-93, 19.
[33] Palmieri, ref. 8, 175-6.
[34] French, Helen S., Wellesley Alumnae Magazine XIII, (1929), 287-288.
[35] Abbott, ref. 23, 330.
[36] Wellesley College Calendar, 1877-78, 34.
[37] President's Report, Wellesley College, 1892-93, 20.
[38] President's Report, Wellesley College, 1893-94, 10.
[39] Rossiter, ref. 3, 1.
[40] Hackett, ref. 10, 90-96.
[41] Johnson, R. H. and Stutzmann, B. J., The Journal of Heredity VI, (1915), 250-253.
[42] Abbott, ref. 23.
[43] Palmieri, ref. 8, 31.
[44] Onderdonk, Virginia, "The Curriculum," in Glasscock, Jean, Ed., Ref. 13, 136.
[45] Ref. 44.
[46] Smith, ref. 1, 19.
[47] Ref. 1, 2.
[48] Lewenstein, ref. 6, 40.
[49] Ref. 6, 39.
[50] Palmieri, ref. 8, 217-8.
[51] Pendleton, Ellen Fitz, The Wellesley Alumnae Magazine Quarterly VI (1922), 147-149.
[52] Wellesley College Annual Report, 1928-29, 12.
[53] Ref. 52.
[54] Palmieri, ref. 8, 176, and many annual reports.
[55] Wellesley College President's Report, 1895, 17-18.
[56] Wellesley College Annual Report 1908, 11; 1909, 14.
[57] Balderston, in Glasscock, Jean, Ed., ref. 13, 348.
[58] Palmieri, ref. 8, 235.
[59] Wellesley Alumnae Quarterly IV (1920) 72.
[60] Chemistry Department Annual Report, 1926.
[61] Wellesley College Annual Report, 1903, 7.
[62] Wellesley College President's Report, 1906.
[63] Chemistry Department Annual Report, 1915.
[64] Chemistry Department Annual Report, 1926.
[65] Palmieri, ref. 8, 123.
[66] Rossiter, ref. 3, 18.
[67] Wellesley Alumnae Quarterly IV (1920) 71.
[68] Ref. 67.
[69] Wellesley College Calendar, 1920-21.
[70] Wellesley College Calendars.
[71] Annual Report of the Chemistry Department, 1921-22.
[72] Chemistry Department Annual Reports.

[73] Wellesley Alumnae Magazine II (1918) 96-97.
[74] Chemistry Department Annual Reports, 1917-18 through 1919-20.
[75] Chemistry Department Annual Report, 1915-16.
[76] Chemistry Department Annual Report, 1916-17.
[77] Palmieri, ref. 8, 119.
[78] President's Report, 1924-26.
[79] Zoetmulder, Frances Pettee, Letter to Wellesley Alumnae Magazine 62 (1977).
[80] Wellesley Alumnae Quarterly IV (1920) 71.
[81] Smith, ref. 1, 28-29
[82] Ref. 1, 32.
[83] Ref. 1, 33.
[84] Ref. 1, 35.
[85] Ref. 1, 43-44.
[86] Ref. 1, 51.
[87] Ref. 1, 36-39.
[88] Ref. 1, 72.
[89] Ref. 1, 82.
[90] "Minimum Standards Used as Criteria in Evaluating Undergraduate Professional Training in Chemistry," American Chemical Society, Committee on Professional Training, 1954.
[91] Lewenstein, ref. 6, 41.
[92] Onderdonk, ref. 13, 149.
[93] Ref. 13, 154.
[94] Ref. 13, 148.
[95] Ref. 13, 156-158.
[96] The New York Times, October 26, 1940, etc.
[97] The Wellesley Magazine 5 (1949), 232-237, 270.
[98] Schafer, Alice T., Wellesley Alumnae Magazine 48 (1964) 86-89, 109-110.
[99] Chemistry Department Annual Report, 1935-36.
[100] Griggs, Mary A., "Science Building for Wellesley College," The Nucleus XIII (Feb. 1936).
[101] Chemistry Department Annual Report, 1938-39.
[102] Wellesley College Bulletin, 1944-45, 56-60.
[103] Letter from Helen T. Jones, Chairman, to Ella Keats Whiting, Chairman of Wellesley's Curriculum Committee (October 8, 1944).
[104] Wellesley Alumnae Magazine 54 (1969), 20.
[105] Chemistry Department Annual Report, 1956.
[106] WCIIC Proposal to National Science Foundation Special Projects Program, 1971; also Wellesley Alumnae Magazine 52 (1967) 22 and 54 (1969) 6-7.
[107] Letter from Ruth Johnstin to President Mildred McAfee, June 25, 1940.
[108] The Wellesley Magazine 4 (1948) 172-174.
[109] Jones, Helen T., Wellesley Alumnae Magazine 54 (1969) 37.
[110] Wellesley Alumnae Magazine 47 (1962) 14-16.
[111] This section is based on interviews with and letters from a member of the Wellesley Class of 1942, who chooses to remain anonymous and is called B. D.
[112] Bishop, Joan Fiss, Wellesley Alumnae Magazine 37 (1952).
[113] Smith, ref. 1, 83.
[114] Horowitz, ref. 12, 353.
[115] Rayman, Paula and Brett, Belle, *Pathways for Women in the Sciences*, *Part 1,* (Wellesley College, Center for Research on Women, Wellesley, MA, 1993), 113.
[116] Ref. 115, 77.
[117] Civian, Janet T., *Pathways for Women in the Sciences*, *Part 2,* (Wellesley College, Center for Research on Women, Wellesley, MA, 1997), 74-76.
[118] Ref. 116, 111.
[119] Ref. 116, 77.
[120] Ref. 116, 80.