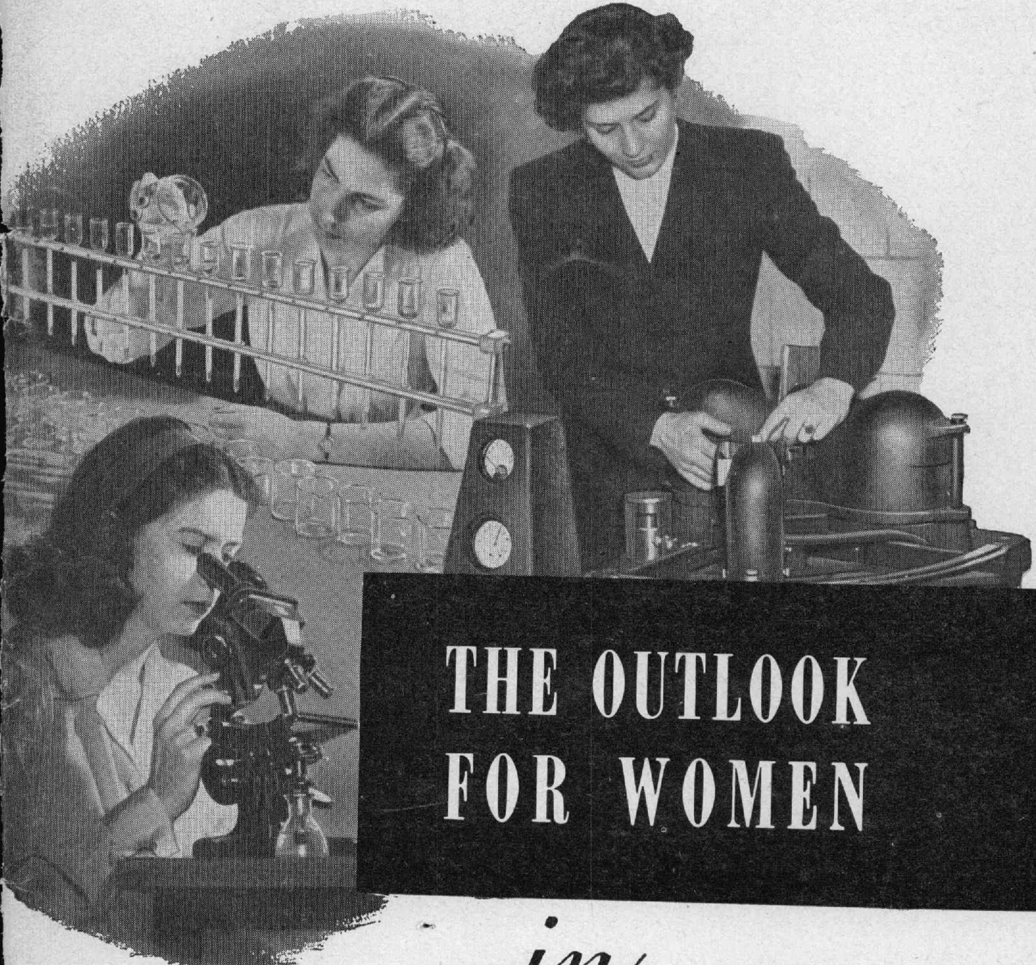

THE OUTLOOK FOR WOMEN *in* CHEMISTRY

Bulletin No. 223-2

U. S. DEPARTMENT OF LABOR

WOMEN'S BUREAU

UNITED STATES DEPARTMENT OF LABOR
L. B. SCHWELLENBACH, SECRETARY
WOMEN'S BUREAU
FRIEDA S. MILLER, DIRECTOR

The Outlook for Women in Chemistry

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No. 223–1 *The Outlook for Women in Science*

No. 223–2 *The Outlook for Women in Chemistry*

No. 223–3 *The Outlook for Women in the Biological Sciences*

No. 223–4 *The Outlook for Women in Mathematics and Statistics*

No. 223–5 *The Outlook for Women in Architecture and Engineering*

No. 223–6 *The Outlook for Women in Physics and Astronomy*

No. 223–7 *The Outlook for Women in Geology, Geography, and Meteorology*

No. 223–8 *The Outlook for Women in Occupations Related to Science*

Note on Pagination.—Throughout the series, page numbers show both the volume number and the page number in that volume. For example, page 24 in volume 3 is shown as 3–24; in volume 6, as 6–24.

LETTER OF TRANSMITTAL

United States Department of Labor,
Women's Bureau,
Washington, December 22, 1947.

Sir: I have the honor of transmitting a description of the outlook for women in chemistry which has been prepared as a part of a study on the outlook for women in science. The extraordinary demand for women with scientific training during World War II and the resulting questions which came to the Women's Bureau prompted us to undertake this study. The paucity of published information on women in science and the encouragement of the scientists and educators who were consulted in the course of this study confirmed the need for the information here assembled and synthesized. The study was planned and directed by Marguerite Wykoff Zapoleon and completed with the assistance of Elsie Katcher Goodman and Mary H. Brilla of the Employment Opportunities Section of the Bureau's Research Division. Other members of the Bureau staff who helped to broaden the coverage of this study through interviews in the field were regional representatives Margaret Kay Anderson, Martha J. Ziegler, Rebecca G. Smaltz, and another member of the research staff, Jennie Mohr. Corinne LaBarre, research assistant, of the Western Personnel Institute, Pasadena, Calif., furnished the information obtained from western colleges.

The part of the study here transmitted was written by Marguerite Wykoff Zapoleon.

Respectfully submitted.

Frieda S. Miller, *Director*

Hon. L. B. Schwellenbach,
Secretary of Labor.

FOREWORD

Much has been written about science and scientists, but little has been told about the work women trained in science have done and can do in the future.

Although these women are few in number when compared to men in science or to women in such occupations as teaching and nursing, their contribution to the national welfare, so strikingly demonstrated in World War II, goes forward daily in the laboratories, classrooms, offices, and plants in which they work.

The every-day story of where these women work, of what kind of work they are doing, and of what other young women who join their ranks in the future may do has been the subject of this report on the outlook for women in science. Unlike the usual monograph which describes an occupation in detail at a particular point in time, this study, like the Women's Bureau series on occupations in the medical and health services which preceded it, is concerned primarily with changes and trends.

Although more than 800 books, articles, or pamphlets were culled for background information, the principal raw material for the entire study of which this bulletin is a part came from such primary sources as scientific organizations, employers and trainers of women scientists, and men and women scientists themselves. Principal sources were as follows:

Scientific organizations: The National Research Council supplied useful directories of scientific laboratories and organizations. Helpful criticism and direction to other authorities were obtained from its Office of Scientific Personnel. Sixty separate organizations of scientists supplied information on their women members, by interview or correspondence.

Federal agencies: Unpublished information on personnel in scientific fields was supplied by:

The United States Bureau of Labor Statistics,
The National Roster of Scientific and Specialized Personnel,
The United States Office of Education,
The United States Civil Service Commission, and
The United States Public Health Service.

In addition, 52 separate bureaus, offices, or other operating units of the Federal Government known to employ scientists were solicited for information regarding the number of women employed on jobs requiring scientific training and the type of work they were doing. Detailed statistics over a period of years were available from some agencies, while only fragmentary data were obtained from others. The women's military services likewise supplied information on the wartime use of women trained in science in the WAC, WAVES, and the Marine Corps.

Private industry: One hundred industrial firms were visited in 1945 and 1946 to obtain information, usually by interview with the director of research or the personnel director, on the women employed by any part of the organization in any capacity requiring scientific training of college level. Prewar, wartime, and postwar statistics were obtained where available, as well as suggestions and comments. In many instances, some of the women in scientific work were interviewed on the job. The firms visited included:

Seventy-eight firms listed in the National Research Council's 1946 directory of 2,443 firms having research laboratories. The firms visited are listed in the directory as employing 24,816 persons as scientific or technical personnel in their laboratories. This number represented 28 percent of the total personnel of this type estimated as employed in all the laboratories listed. In addition to this numerical coverage, an attempt was made to include among the 78 firms visited small as well as large firms, plants in all parts of the United States, and a variety of industries. However, the intricate industrial organization, inter-relationships, and variety of research revealed in the directory, added to the fact that some firms did not report personnel statistics and none reported women separately, made the selection of a true sample complicated beyond its value for this purpose. The firms visited were chosen rather as a clue to industrial firms most likely to be engaged in the type of work in which women trained in science are used. In all firms, information was requested for the entire organization rather than for the research laboratory only.

Eighteen commercial testing laboratories which offer testing services to industry and individuals and which employed women were also visited. Seven others contacted did not employ women. These 25 laboratories represented 10 percent of the 244 commercial testing laboratories listed in the National Bureau of Standard's 1942 Directory of Commercial Testing and College Research Laboratories. Since personnel is not reported in the Directory, there is no clue to the coverage of workers.

Three large additional industrial firms which employed women in laboratory work but were not listed as having research laboratories were visited, as was one biological supply house.

Research institutions: Eight research institutions or centers, some of them identified with a particular college or university, also supplied information on women members of the scientific staff.

Colleges and universities: Statistical information on the number of women graduated with degrees in science, mathematics, and engineering over a period of years from 1939–40 to 1946 was obtained from 30 colleges and universities and from 9 engineering schools. Again an attempt was made to obtain wide geographical coverage and to cover different types of institutions, such as women's colleges, State universities, and small liberal arts colleges. The information available from these sources, too, varied. Placement bureaus and heads of science departments as well as deans of women at these institutions and at six other colleges contributed reports on the demand for women trained in the sciences. The Western Personnel Institute made possible the inclusion of data which it collected for the Bureau from its affiliated colleges and universities in the far West.

Since no recent data were available on the number of women teaching science in the colleges, a count was made in 1947 of the women identifiable by name who were listed on science faculties in the catalogs of 330 institutions of higher learning which were then available in the United States Office of Education Library. These institutions were selected because they are believed by the United States Office of Education to be representative in their enrollments of the 1,749 institutions of higher education in the United States and, therefore, are likely to have faculties equally representative.

Other sources: In addition, 97 individuals not included in the afore-mentioned sources, most of them women scientists, contributed information, suggestions, or helpful criticisms of the preliminary manuscripts circulated before revision for publication.

While every effort has been made to obtain wide coverage, there remain some dark corners still unexplored because of the range and variety of these fields and the difficulty of obtaining information from widely scattered sources. Perhaps this beginning will result in further additions to our so-little knowledge.

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Nutrition research

Courtesy Mellon Institute

Medical research

Courtesy Science News Service

Industrial research

Courtesy DuPont Company

Figure 1.

Some Positions Held by Women With Degrees in Chemistry

"I work for a company that makes all kinds of equipment for the identification of textile fabrics. Our laboratory has developed an indelible marking ink which is invisible in daylight or artificial light, but which shines out bright blue when viewed under 'black light.' My job consists in preparing the ingredients of this invisible ink and also the ink itself. I also do research on all types of problems involving textile identification and marking, both invisible and visible."

"I analyze fats and oils in a foods laboratory, determining the melting point, setting point, and iodine number."

"As a senior control chemist in a cosmetics company, I do most of the analyses of special nature as well as the regular soap analysis. I make solutions for the laboratory and for various departments through the plant. I assign work to and check the performance of the junior control chemists who make crude glycerine analyses and test raw materials and such finished products as powder and creams."

As an organic chemist in a pharmaceutical firm, "I do research on medical compounds of various types. At present, I'm working on the problem of local anesthetics."

"Serving on the faculty of a medical school I teach classes in pediatrics and in addition, accumulate extensive data on blood chemistry, circulation and respiratory changes in fatigue. During peacetime, my studies have been directed toward the management of heart diseases in children; during the war, toward the study of the physical fitness of soldiers in instances of delayed convalescence."

"As a technician in the research and developmental laboratory of a plant manufacturing glass products, I develop experimentally new products or develop the application of standard processes (or variations of standard processes) to new products or products in service, or perform experimental test work on general glass problems, as assigned."

Chemist as Defined in the Dictionary of Occupational Titles (*46*)

"Chemist (professional and kindred) 0–07.80. Performs analytical and research work of a professional nature in the general field of chemistry: makes quantitative and qualitative analyses to determine chemical and physical properties of materials. Makes chemical tests on manufactured goods, such as foods, drugs, plastics, dyes, paints, and petroleum products, and develops new processes to improve products. Supervises other workers in laboratory research or industrial control activities and prepares technical reports."

Chemist as Defined by the Council of the American Chemical Society, 1944 (*18*)

"A chemist is one properly versed in the science that treats of the composition of substances and the transformations they undergo."

THE OUTLOOK FOR WOMEN IN CHEMISTRY

Chemistry easily outstrips all the other sciences in its employment of women, and also of men, if the applied sciences of engineering and medicine are excluded. In 1946, between 5,000 and 6,000 women chemists, with at least the bachelor's degree or its equivalent in experience, were employed in chemical laboratories or in related work in the United States. The proportion of all chemists who are women is relatively small, however, roughly 6 percent or 1 out of 16. In astronomy and mathematics as well as in the principal biological sciences, the percentage women form of all those employed is higher than in chemistry. However, the number of women in all these fields combined is less than the number of women in chemistry (*50*).

Because World War II created an insatiable demand for chemists and at the same time diverted into military service many of the men available for laboratory work, women chemists were prized, and young women were urged to train for chemical laboratory work.

At the end of the war, as men returning from service resumed their jobs in laboratories or their college training, women began to ask:

Will the demand for women chemists continue at wartime levels?

Has the increase in the number of women in chemistry during the war improved or reduced the employment chances of college women training for chemical work?

Are there certain chemical fields which offer greater opportunity for women than others?

To answer these and similar questions, it is necessary first to look backward to see how women chemists fared before the war.

Prewar Distribution

In 1940, according to the Bureau of Census, 1,654, or about 3 percent of the 57,025 chemists, assayers, and metallurgists employed in the United States were women (*44*). These totals do not include many teachers of chemistry who were counted as teachers rather than as chemists.

Where women chemists were employed and what kind of chemical work they were doing was not reported by the Census. But an indi-

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cation of their duties is available from studies of two groups of women chemists:

(1) Those well-trained and experienced enough to qualify for membership in the American Chemical Society (almost half of the women members in 1941 had a Ph. D., and one-third had a master's degree) (*2*);

(2) Some of the younger, less experienced women who were graduated with a bachelor's degree in chemistry not long before World War II (*23*).

Type of Employment

In both groups, teachers of chemistry were most numerous. More than one-third of the more experienced women chemists were teaching, most of them on college faculties; one-fourth of the younger group were also teaching, the majority in high schools.

Research work absorbed the next largest group of the women members of the American Chemical Society, almost one-fourth of them, while only one-tenth of the more recent graduates were in research. One-fourth of the latter, however, were engaged in further study, preparing themselves for later research, college teaching, or for a related profession such as medicine. The women already in research work were engaged mostly in basic scientific study not directly related to industrial or other practical problems. In this, they differed from men chemists, for whom industrial research was the largest single outlet.

The general belief that most women chemists in laboratories are engaged primarily in the analysis or routine testing of raw materials, finished products, or goods in process, while most men chemists are engaged in research, is apparently true if all chemists are considered. However, table 1 shows clearly that even before the war the proportion of experienced women chemists who were engaged in analytical work was actually lower than that of a comparable group of men. The explanation may be found by looking at the less experienced group of women. A much higher proportion of them, about one-fourth, were doing analytical work, usually in hospital or other medical laboratories rather than in industry.

The chief differences in the type of employment of men and women chemists before the war were: the lower proportion of women in industrial research, their lower proportion in administration, and their higher proportion in teaching. (See table 1.) The higher proportion of women chemists in chemical library and information service was also significant.

Table 1. Type of Occupation of Men and Women Members[1] of the American Chemical Society 1941, Compared With That of Less Experienced Group of Women in Chemistry 1938

Type of occupation	Group I: Members[1] of American Chemical Society reporting 1941 occupation				Group II: Women graduated with majors in chemistry 1934–38 reporting 1938 occupation in chemistry	
	Number		Percent		Number	Percent
	Men	Women	Men	Women		
Total	14,801	671	100.0	100.0	719	100.0
Teaching	2,184	232	14.7	34.6	191	26.5
College	1,960	198	13.2	29.5	21	2.9
High school	173	28	1.2	4.2	170	23.6
Other	51	6	.3	.9	(2)	(2)
Research	5,092	150	34.4	22.4	72	10.0
Basic science	1,028	110	6.9	16.4	(2)	(2)
Industrial research	4,064	40	27.5	6.0	20	2.8
Medical research	(2)	(2)	(2)	(2)	52	7.2
Analysis and testing	2,205	88	14.9	13.1	185	25.8
Medical	(2)	(2)	(2)	(2)	155	21.6
Industrial	(2)	(2)	(2)	(2)	30	4.2
Library and information service	29	47	.2	7.0	23	3.2
Technical secretarial service	(2)	(2)	(2)	(2)	28	3.9
Further study	837	42	5.7	6.2	184	25.6
Administration	2,119	28	14.3	4.2	(2)	(2)
All other	2,335	84	15.8	12.5	36	5.0

[1] Excludes male chemical engineers. It was possible to exclude the chemical engineering group from the figures for men, since the 3,645 male chemical engineers were reported separately. However, it is possible that a maximum of 7 chemical engineers may be included among the 671 women members reporting 1941 occupation.
[2] Not reported separately.

Sources: For Group I—1944 Study of the American Chemical Society (3). For Group II—1939 Study by Ethel L. French (23).

Type of Employer

More marked than the differences in the kind of work done by men and women chemists before the war were the differences in the type of establishments in which they worked. (See table 2.) Almost two-thirds of the men members of the American Chemical Society, excluding those in chemical engineering, reported that they were employed by private industrial firms in 1941; but only one-fourth, roughly, of the women chemists were working in industry. For the women, Government and educational agencies were more important sources of employment. Less than 3 percent of both women and men chemists were self-employed in consulting work. In this they differ from those engaged in such professions as law and medicine, where private practice predominates.

Educational Institutions.—The largest number of women chemists, almost one-third, were employed in educational institutions, mostly in colleges, where they comprised 10 percent of the chemistry faculties, according to a 1939 survey by Ethel L. French (*23*). Their proportion was lower (8 percent) among full professors of chemistry and higher (17 percent) among instructors. The virtual requirement of graduate work for college teaching positions was shown by the fact that more than three-fourths of the chemistry faculty had their doctorates, and a meager 2 percent had only the bachelor's degree. The low proportion of women among graduate assistants and fellows, on the one hand (8 percent), and their equally low proportion among full professors, on the other, were related, but which was cause and which effect is debatable. The number of women teaching chemistry in high schools before the war is not known.

Table 2. Distribution of Men and Women Members[1] of the American Chemical Society by Type of Employer Reported in 1941

Type of employer	Number		Percent	
	Men	Women	Men	Women
Total	14,858	674	100.0	100.0
Educational institutions	1,872	216	12.6	32.0
Government	2,961	186	19.9	27.6
Private firms[2]	9,058	183	61.0	27.2
Research institutes	391	37	2.6	5.5
Consulting[3]	377	17	2.6	2.5
All other	199	35	1.3	5.2

[1] Excludes male chemical engineers. It was possible to exclude the chemical engineering group from the figures for men, since the male chemical engineers were reported separately. However, it is possible that a maximum of 7 chemical engineers may be included among the women members reporting 1941 employment.
[2] Includes private firm, company, corporation, or organization engaged in activities other than those listed separately.
[3] Laboratory, firm, or office.

Source: 1944 Study of the American Chemical Society (3).

Government.—Government ranked second to education and only slightly higher than industry as an employer of women chemists in 1941.

Principal employers were the State and local public health agencies and public hospitals, which employed women chemists in medical laboratories. About 50 women were employed in the Federal Government as "chemists or metallurgists," 3 percent of the total in that group, if statistics for the end of 1938 obtained from the United States Civil Service Commission are indicative (*53*). No woman was appointed as a chemist from Federal Civil Service registers in the year ended June 30, 1940, but 123 men were so appointed, many as junior chemists (*42*).

Most of the women chemists in the Federal Government worked in the United States Department of Agriculture's Bureau of Human Nutrition and Home Economics laboratories, but a few were in the Food and Drug Administration, where they analyzed samples collected by field inspectors from factories and warehouses. The National Institute of Health also had a few women biochemists on its staff, and in the Patent Office several women chemists examined applications for patents. The National Bureau of Standards and at least one of the Army arsenals employed women in chemical laboratory work. A few women chemists were also serving as librarians or doing technical editing or writing in Government units specializing in scientific work.

Industry.—Private industry ranked with Government in its employment of women chemists who were members of the American Chemical Society.

A picture of the industries and occupations which engaged women trained in chemistry before the war has been obtained by the Women's Bureau from more than 100 industrial firms, including 78 listed by the National Research Council as having research laboratories and 18 commercial testing laboratories (*34*). More than half of these firms, actually 55, employed women chemists prior to World War II. Forty-two had women chemists in their laboratories at the outbreak of the war, although in seven of them women chemists were confined to desk work as technical librarians, patent searchers, chemical secretaries, or technical file clerks. Six additional firms had previously employed women in chemical laboratory or technical librarian work but had none on the pay roll just before the war. In fact, two of these had introduced women into their laboratories only during World War I and had replaced them with men as they left, in some cases long after the war. The exact numbers of women employed just before World War II were obtainable from only half the firms included in the Women's Bureau survey, but the number usually ranged from 1 to 10 in each establishment. Only a few of the larger corporations employed more than 25.

The firms which employed women chemists in laboratory work represented a variety of industries including such widely differing ones as: transportation equipment, textiles, leather, mail order, and machinery. However, more than two-fifths, 41 percent, of these firms were chemical manufacturers. Food manufacturing firms and commercial laboratories (which specialize in the testing of products for firms or individuals without testing facilities of their own) ranked next.

This predominance of the chemical and food industries in the industrial employment of women chemists was verified in the survey of the American Chemical Society. Fifty-eight percent of the 183 women members reporting employment in industry in 1941 were with chemical or food firms. Petroleum and coal products ranked next, with 11 percent (*3*).

Other Employers.—Research institutions employed some women chemists before the war. The Rockefeller Institute, for example, had 19 women technicians with a bachelor's degree who had majored or minored in chemistry. The Carnegie Institution of Washington in its Department of Geophysical Magnetism employed one or two women as analytical chemists. The Mellon Institute in Pittsburgh, too, had a small number of women chemists on its staff.

Type of Specialization

Although women were found in almost every type of specialization within the field of chemistry, they tended to concentrate in certain types. In this, their distribution differed from that of men chemists. Of 663 women members of the American Chemical Society who reported their 1941 specialization, the largest number, 123, were in

Courtesy DuPont Company

Figure 2.—A laboratory assistant in a chemical manufacturing company.

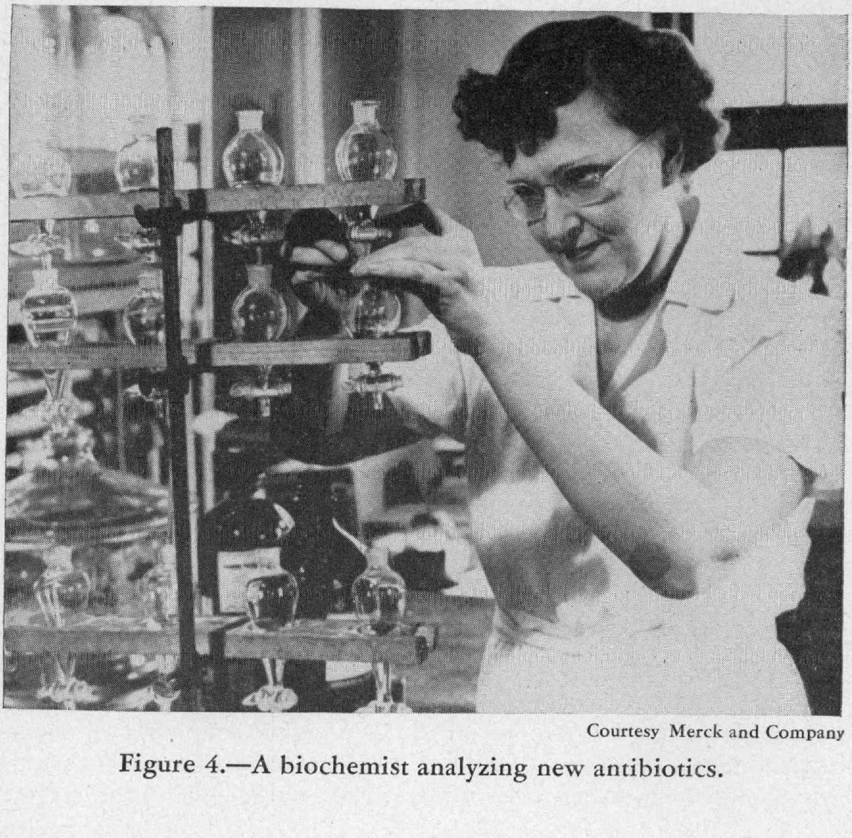
Courtesy Merck and Company

Figure 3.—Using special techniques in physical chemistry to analyze the composition of a streptomycin compound.

biological chemistry, sometimes called physiological chemistry. This has to do with the chemistry of the life processes in man or in plants and animals. Next in order were: organic chemistry (which deals mainly with carbon compounds), physical chemistry (which is concerned with the measurement of the physical properties of chemical compounds), general chemistry, foods and kindred products, medical chemistry, and pharmaceuticals. For men members, the largest fields of specialization were: physical chemistry, organic chemistry, organic chemical technology, general industrial chemistry, petroleum and its products, foods and kindred products, and pharmaceuticals (*3*).

The greater tendency of women to specialize in biochemistry and organic chemistry was evident in teaching but only at the graduate level (*23*). Women teaching undergraduate courses in chemistry in colleges and universities had teaching assignments similar to those of men, with more than half in inorganic chemistry, more than one-fourth in organic, and one-sixth in physical chemistry. In graduate schools the percent distribution for women was likewise similar to that of the men except in organic and biological chemistry which together accounted for 48 percent of the women's and 36 percent of the men's teaching load.

Every one of the 8 women among 77 chemists who applied to the Lalor Foundation for a postdoctoral fellowship in chemistry in 1937 were biological chemists. Practically all were concerned with physiological or nutritional problems. This tendency for women to specialize in biological and organic chemistry may be due in part to the



Courtesy Merck and Company

Figure 4.—A biochemist analyzing new antibiotics.

curricula of the institutions in which they train, in part to the belief that biology may be more generally useful to women, and in part to a reflection of the demand for women chemists. One instructor of chemistry in a woman's college believes that women have a natural interest in medicine on the theoretical but not on the practicing side. Graduate work in biochemistry is therefore more to their liking than the study of medicine itself.

Prewar Demand and Supply

Eighty, or 4.6 percent, of the experienced women chemists in 1940 were seeking work, according to the Census, roughly the same proportion as those unemployed among the men (*44*). Although the rate of unemployment for chemists was less than that for all professional and semiprofessional workers, it prompted the American Chemical Society in its 1939 publication on Vocational Guidance in Chemistry and Chemical Engineering to state:

> Chemistry today like all professional fields is overcrowded. It should be emphasized that steady employment is afforded to only the best qualified who achieve excellence by diligent preparation. Unemployment is found generally in the lowest levels, in spite of the increase in the number of new chemical industries and marked expansion of those already established (*4*).

In the same year, the research director of a large chemical corporation wrote in the Journal of Chemical Education:

> * * * our schools are turning out chemically trained graduates at a rate probably somewhat greater than the industry can absorb (*29*).

These statements describe an oversupply. Between the Census of 1930 and that of 1940, the number of chemists had increased by about 25 percent (*43*). In 1940, 4,374 senior students in more than 500 colleges and universities were expected to receive their bachelor's degrees in chemistry, and more than 1,000 were working toward their master's or doctor's degrees (*14*). (This did not include the more than 2,000 candidates for degrees in chemical engineering.) The total, 5,470, equaled almost 10 percent of all employed chemists in 1940; the bachelor group alone was equivalent to about 8 percent. By comparison, although the difference in length of training must be kept in mind, the 5,097 graduated by medical schools in 1940 equaled 3 percent of all practicing physicians.

At the doctorate level, too, the production of chemists was greater than in comparable fields. Actually, the number of doctor's degrees granted in chemistry in the decade ended in 1939–40 exceeded the number granted in any other single department, with those in education and English ranking next in order, according to an American

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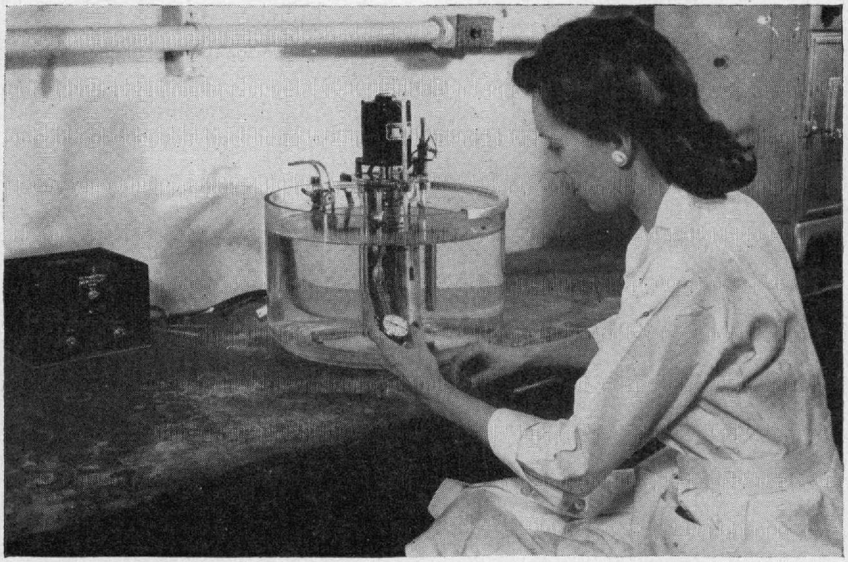
Council on Education survey (*27*). In that period almost 4,000 persons received the doctor's degree in chemistry in addition to more than 500 in biochemistry. Almost two-thirds of these chemists and more than half of the biochemists who reported their employment at the time of the study were engaged primarily in research. Less than one-third were primarily in teaching. This means that the employment of chemists at the doctoral level before the war depended more upon the demand for research than upon the demand for educational or other services. In this it represented one extreme in comparison with other fields in which the doctorate is offered. The other extreme was English, in which 5 percent were primarily in research and almost 90 percent in teaching.

Separate statistics on the number of women receiving the doctorate were not available, but just before the war the number of women graduated each year with bachelor's degrees in chemistry has been estimated at about 500 (*65*). This would be about 11 percent of all graduates with bachelor's degrees in chemistry in a single year, which checks almost exactly with the percentage women were among the co-educational college majors in chemistry as shown in the 1939 study by Ethel L. French (*23*). The first comprehensive figures on women graduates with bachelor's degrees in chemistry are for the war year of 1942, when the United States Office of Education reported that 835 women received such degrees, 20 percent of a total of 4,116 bachelor's degrees in chemistry (*56*).

Although reports from placement bureaus and comments from women chemists indicate that women graduated with majors in chemistry found jobs in which their training was useful, one woman chemist in 1939 described the situation as follows:

> During the past few years women chemistry graduates have found it difficult to secure employment in positions for which their training had supposedly qualified them (*23*).

Perhaps this discouraging state was responsible for the slight decline of some 200 in the number of women chemists between 1930 and 1940 (*43*). During this period, teaching, medical laboratories, and such nonlaboratory jobs as technical library, editing, and secretarial work were the principal outlets for women. Openings for them in industrial laboratories were rare and seldom occurred outside pharmaceutical laboratories. Women interested in chemistry were advised to seek work in fields related to home economics (textiles or foods) or to biology (in medical laboratories or pharmaceutical firms). They were advised to take special training in home economics, biology, or nursing to improve their chances for employment.



Courtesy Ralston Purina Co., Inc.

Figure 5.—A woman with a major in chemistry conducting mineral analysis on feedstuffs.

Wartime Changes

Increase in Demand

World War II transformed this picture suddenly. As early as 1942, and rising to a peak in 1943–44, the demand for women trained in chemistry became not only fantastic in relation to the supply available but virtually nondiscriminating. According to reports from the colleges, the poorest student in chemistry had an almost infinite choice of jobs. A southern school which had never had any calls for women graduates in chemistry before the war reported 353 openings in 1944. An experienced woman chemist, interested in changing positions in 1944, was interviewed by 71 employers at a meeting of the American Chemical Society at which an employment clearing house was conducted for members (*7*). Previously unheard-of calls for girls with a course in high school chemistry to work as laboratory assistants were received by high school placement bureaus, as early as 1942.

In Industry.—In Cleveland, the number of women employed in local industrial laboratories in 1944 was declared to be "little short of miraculous." Half or more of the analytical laboratory and metallurgical laboratories personnel of one large metal plant in 1944 were women (*17*). In Detroit, the technically trained women on the staff of one local company had increased 450 percent, and one-fifth of its testing and chemical research staff were women (*32*).

By far the largest increase was in chemical manufacturing. First, the munitions plants, which normally employ few women because of the hazards involved, began to hire women as chemists, laboratory technicians, and assistants. A number of women teachers of chemistry were recruited for these plants to train the routine testers, many of whom had had little or no college chemistry. Synthetic rubber laboratories followed suit.

The rapidly growing plastics industry also employed women, especially those with specialization in organic chemistry, as plastic substitutes were developed for certain metals and other scarce products or parts (*40*). An enormous increase in the number of women employed in laboratory work in paper mills, which normally employ few women, was revealed in a 1943 survey covering approximately half of the total employment in this industry. The number of women fully qualified as chemists had increased from 5 in 1941 to 41 in 1943. Below the skill level of the chemist, 500 women were employed as laboratory testers and 47 as laboratory inspectors, as compared with 13 testers and no inspectors 2 years earlier (*12*).

In oil refining the increased need for high-octane gasoline and other petroleum products created an overwhelming demand for careful control work in the laboratory. Almost all the oil companies hired large numbers of women with high school education or some college work (preferably with courses in chemistry), who were trained to do routine testing but were not in any sense chemists. However, a smaller number of college graduates in chemistry or teachers of chemistry were hired to supervise them and to handle the more difficult control problems.

In the metal industries, where women have been traditionally few both in the plant and in the laboratory, women were sought for laboratory work. An iron mining company, with its staff of ore analysts cut in half, trained women with college chemistry to make determinations of iron, manganese, phosphorus, and other chemicals in the ore to grade it for steel-making. In steel mill laboratories, women were trained to run analyses of molten samples of the steel brought from the furnaces at various stages in its manufacture. As in other laboratories, a Women's Bureau representative found in a wartime survey of the steel industry that the testing processes were broken down, so that much of the routine testing could be done by women without degrees in chemistry working as laboratory aids. Devices for the routine testing of the hardness of steel and of carbon content were operated by women, and they assisted the chemists in preparing samples for inspection (*55*). Later a number of women were trained to take readings on the spectograph and to make the appropriate calculations of wave lengths to identify metals.

The highly publicized increased use of women in chemical laboratories was verified by the reports obtained by the Women's Bureau from the 100 firms visited in its special survey of laboratories. Eighty-two of these firms employed women, with at least some college chemistry, in their laboratories during World War II, compared to 42 at its outbreak. An additional 4 firms employed women high school graduates as laboratory assistants but had none with college background. The increase in the number of firms using women was greatest for commercial testing laboratories and for firms engaged in the manufacture of paper, metal, glass, and petroleum products.

In any one firm, however, the wartime number of women with college degrees in chemistry employed in laboratory work was more likely to be under 20 rather than over, except in very large corporations. Only at the lower level of routine testing in oil refining, in munitions, and in similar work where high school women were used were the numbers larger, often in the hundreds. Many of these non-chemists were trained on the job or in brief Engineering Science and Management War Training courses to do such laboratory operations as filtering, weighing, matching of colors, and specimen polishing, and to operate laboratory equipment and record data.

In Federal Government, Civilian and Military.—The wartime demand for chemists in Federal Government service, as in industry, was overwhelming, especially at the lower professional grades. The United States Civil Service Commission in 1942 opened examinations for chemists, for junior chemists, and for chemical aids. The junior-chemist announcement predicted: "Unusual opportunities for women throughout the United States."

Part of the demand was new and came from the War and Navy Departments and such war agencies as the Office of Scientific Research and Development, the Office of Emergency Management, and later, the War Production Board and the Office of Price Administration, which used chemists on problems of allocation of chemicals and on the pricing of chemical products. Part of it stemmed from war projects assigned to established agencies like the National Bureau of Standards and the Bureau of Mines. Some of it was caused by the need to replace young men chemists who were drafted.

The total number of women chemists employed by the Government at the peak of the war is not known. But statistics from 12 separate bureaus, administrations, and offices indicate that these alone employed approximately 250 women chemists, including 10 to 15 metallurgists, as compared with a probable maximum of 50 for all agencies

Courtesy U. S. Department of Agriculture

Figure 6.—A chemist in a Federal laboratory determines the particle size of DDT crystals in a sample under test.

before the war (*53*). These figures do not, of course, include the scientific or laboratory aids with experience or training below the level of the junior chemist. The Bureau of Mines, alone, employed almost 150 women as such aids in its laboratories and pilot plants during the war, and the Chemical Corps of the War Department employed more than 100. Since many other agencies have no separate records of the number of women chemists employed and since others group the chemists under a general heading like "physical science personnel," the picture painted by these partial statistics is far from complete.

In military service, some women were also assigned to chemical laboratory work. In the United States Marine Corps Reserve, 12 women were chemical laboratory technicians, and 1 was a chemical warfare specialist. Among the jobs filled by members of the Women's Army Corps, were those of chemist, chemical laboratory assistant, and chemical noncommissioned officer (*63*).

In the WAVES, some women with bachelor's degrees in chemistry were used on work requiring a science background, such as radio, radar, and electronics work. Some tested electronic tubes and other materials and equipment; others, as assistant engineers, wrote specifications, assisted in the distribution and surveys of spare parts, which required technical knowledge, or they assisted in research, especially on calculations and compiling of technical data. One, who had had brief experience with a paint company, worked on paint finishes for electrical equipment that would be proof against moisture and fungi. A few, after 4 months' training in a Naval Air Navigation School followed by 6 weeks' training in a Celestial Link Trainer School, became instructors who taught Navy cadet pilots celestial navigation and related subjects. Some also became medical technicians, working, for example, on the collection of blood and its processing for serum.

In Research Institutions.—Much of the war research work of the Government, such as the development of new war materials and processes for manufacture, was contracted out to universities and other research institutions. This resulted in the increased employment of women chemists at many universities, such as the University of Chicago and Columbia University, as well as at research centers, such as the Rockefeller Institute and Carnegie Institution. At the latter, for example, about 20 additional women, most of them with bachelor's or master's degrees in chemistry, were hired as research and laboratory assistants to assist scientists in metallurgy and metallography. A number of women worked on chemical projects connected with atomic research. One woman chemist, working at a woman's college with a few assistants, carried out research on antimalarials. In research institutions, as in industry, no single project employed large numbers of women chemists.

In Teaching.—As some young college instructors and high school teachers of chemistry were drafted and others took work in industry or Government, the demand for women chemistry teachers in colleges and secondary schools increased. By 1943 the shortage of high school chemistry teachers was widespread, as compared to the oversupply that existed before the war (*60*). Chemistry ranked fourth in the list of fields in which college vacancies were most numerous in the fall of 1942. Only in medicine, engineering, and economics were the shortages greater (*58*).

Changes in Distribution

The effect of the wartime demand on the distribution of chemists by type of employer was already evident at the end of 1943. (See table 3.) An increase in the employment of chemists in manufacturing industries and in the Federal Government and a decrease in State and local government employment and in that in educational institutions as compared with 1941 was revealed in a Bureau of Labor Statistics survey which included a sample of nonmembers as well as members of the American Chemical Society.

Within the manufacturing group, there were also changes in the distribution of chemists. The proportion of chemists in textiles declined, while in food industries it remained the same, and in paper and allied products it increased. By far the highest proportion, however, in both years was in the chemical industries, which in 1943 absorbed more than 28 percent. Petroleum and coal products, with approximately 8 percent, iron and steel and nonferrous metals and their products, foods, rubber products, paper and allied products, and textiles ranked next in order (*45*).

Table 3. Percent Distribution of Chemists by Type of Employer in 1941 and 1943

Type of employer	Percent distribution	
	1941	1943
Total	100.0	100.0
Manufacturing firms	58.6	64.0
Other nonpublic organizations	9.5	8.3
Government:		
Federal Government	5.5	7.4
State, county, municipal, and other public authorities	17.0	13.4
Educational institutions	9.3	6.9
Not working	.1	

Source: Bureau of Labor Statistics 1944 Survey (*45*).

Separate figures on all women chemists are not available, but a study of the members of the American Chemical Society indicates that the changes in distribution by employer were similar in nature for men and women members, though the employment increase in industry and in the Federal Government was slightly more marked for the women (*3*).

Although the wartime demand for women chemists was extremely varied, differences persisted in the type of work performed by women chemists as compared with men. These differences in 1943 are summarized in table 4 for 70,000 chemists covered in the Bureau of Labor Statistics survey.

Although, like the men, approximately one-third of the women were engaged in research or development work, a much higher proportion were in basic science research and a much lower percentage in industrial research and development. Analysis and testing, which claimed almost another one-third of the women chemists, absorbed less than one-fourth of the men. College and university teaching, graduate study, and technical service were the other types of employment in which the proportion of women chemists to their total was higher than that of the men. On the other hand, in technical administration and production, the reverse was true.

Table 4. Type of Occupation of Men and Women Chemists, 1943

Type of occupation	Number			Percent		Percent women are of total
	Total	Men	Women	Men	Women	
Total	70, 019	67, 104	2, 915	100. 0	100. 0	4. 2
Research and development	23, 305	22, 397	908	33. 3	31. 2	3. 9
Industrial research	15, 802	15, 386	416	22. 9	14. 3	2. 6
Basic science research	3, 338	2, 960	378	4. 4	13. 0	11. 3
Development	4, 165	4, 051	114	6. 0	3. 9	2. 7
Analysis and testing	16, 656	15, 750	906	23. 5	31. 1	5. 4
Teaching	8, 814	8, 285	529	12. 3	18. 1	6. 0
College and university	4, 520	4, 109	411	6. 1	14. 1	9. 1
Secondary schools	3, 999	3, 882	117	5. 8	4. 0	2. 9
Other	295	294	1	. 4		. 3
Administration, technical	10, 447	10, 297	150	15. 4	5. 1	1. 4
Technical service	1, 436	1, 329	107	2. 0	3. 7	7. 5
Postgraduate study	1, 360	1, 279	81	1. 9	2. 8	6. 0
Production	5, 369	5, 333	36	8. 0	1. 2	. 7
All other	2, 632	2, 434	198	3. 6	6. 8	7. 5

Source: Bureau of Labor Statistics 1944 Survey (*45*) including previously unpublished data on numbers of women chemists.

At first thought one might explain the differences by the fact that fewer women had the doctorate, but a relatively higher proportion of them were in the two fields in which the doctorate is most common: college teaching and basic research. Almost 60 percent of all the college teachers and basic research science personnel in chemistry had the doctorate. At the other extreme, a relatively high proportion of them were also in the field in which the doctorate is seldom found, e. g., in analysis and testing, where only 2 percent had a Ph. D. or Sc. D. Women chemists, then, appeared to form two groups. For those with the doctorate, the chief outlets seemed to be in basic science research and teaching; for those with the bachelor's degree, control work and testing. Complete statistical evidence of wartime shifts in the nature of work done by women chemists is lacking; but, for some 700 to 800 women members of the American Chemical Society who in 1944 reported their employment in 1941 and 1943, an indication of the changes that took place in the work done by the more experienced women chemists is available. (See table 5.)

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The increase is marked in all the groups reflecting industrial demand: industrial research, analysis and testing, and administration. In all of these, women increased not only numerically but in their proportion of the total chemists. In teaching, especially in high schools, and in graduate study, although they declined in numbers, women gained in the percent of the total they formed, as large numbers of men were drawn into military and other war service. Women still composed more than half the chemists engaged in technical library science, although they declined both in numbers and in percent of the total, as laboratory work became available.

Table 5. Type of Occupation of Women Members of the American Chemical Society as reported for 1941 and 1943

Type of occupation	Number		Percent		Percent women are of total	
	1941	1943	1941	1943	1941	1943
Total	671	811	100.0	100.0	3.5	3.8
Teaching	232	221	34.6	27.2	8.4	9.9
College	198	194	29.5	23.9	8.4	9.4
High school	28	24	4.2	2.9	13.6	18.6
Other	6	3	.9	.4	10.2	8.1
Research	150	258	22.4	31.8	2.5	3.6
Basic science	110	121	16.4	14.9	9.4	9.9
Industrial research	40	137	6.0	16.9	.8	2.4
Analysis and testing	88	140	13.1	17.3	3.6	7.2
Library and information service	47	40	7.0	4.9	57.3	54.8
Postgraduate study	42	12	6.2	1.5	4.2	8.3
Administration	28	52	4.2	6.4	.9	1.1
All other	84	88	12.5	10.9	2.1	1.8

Source: American Chemical Society, 1944 Survey (3).

Changes in Supply

As early as the spring of 1944, the American Chemical Society urged the President to safeguard the reservoir of trained chemists and physicists threatened by the draft, from which occupational deferments of chemists had been general up to that time. Magazines and newspapers in late August 1944 and thereafter were filled with protests at the drafting of scientific personnel up to the age of 26 including graduate and undergraduate students in the sciences. The draft continued, although on April 2, 1945, a bill was introduced into the Congress calling for the deferment of students and trained scientists and the discharge from the Army of technically trained enlisted men. Shortages lasting until 1950 and 1955 were predicted, particularly at the doctorate level.

The 3,200 women with college degrees in chemistry who registered with the National Roster of Scientific and Specialized Personnel in

April 1944 and the additional 3,500 who graduated from 1942 to 1944 could not bridge this gap, which was ever-widening under the pressure of increasing industrial demand (*49*) (*51*) (*56*). Women without a college degree but with some training or experience in chemistry helped fill the need. Almost 2,000 women of this type registered with the National Roster in 1944 (*49*). Laboratory work was subdivided as much as possible to utilize the skills and knowledge of the most experienced chemists by broadening their supervision over those with less training. The increase in administrative work reflects this attempt. (See table 5.)

For the most routine jobs high school graduates, with or without chemistry, were trained. But, those with chemical training were preferred, since they were more quickly oriented to the need for precision, the careful handling of equipment, and the scientific atmosphere that characterize even the simplest laboratory.

Emergency War Training.—Many universities offered especially adapted courses to train for war needs. For example, the University of Cincinnati in its College of Liberal Arts offered a 12-month, 48-credit program to prepare women to work as chemical aids. Inorganic chemistry (qualitative and quantitative), organic chemistry, mathematics, and English were included in this course. To train laboratory technicians for work in medical laboratories, a similar program substituting courses in biochemistry and in industrial and pathogenic bacteriology for mathematics and English was also announced as part of its "War Service Training Institute." A special 2-year certificate course for women in chemical engineering was opened by its College of Engineering. Ohio State University under its National Service Curriculum for Women offered four quarters of intensive training in chemistry, mathematics, and physics, plus a period of practical laboratory experience.

Special shorter courses of several months' duration were offered in the field of chemistry in many universities under the federally-financed Engineering, Science, and Management War Training program. Enrollments in such courses totaled 38,838. Almost half were in courses in analytical chemistry; organic chemistry, chemistry fundamentals, physical, biological, and inorganic chemistry ranked next in that order (*59*). No statistics are available on how many women took courses in chemistry. In November 1943, however, women made up more than half the enrollments in analytical chemistry courses, although they comprised only 20 percent of all Engineering, Science, and Management War Training enrollments at that time. The courses given in chemistry in more than 200 universities or technical schools were usually related directly to the needs of a particular wartime industry or Government agency, and the instructors were often industrial men. At first most of the courses trained for work in munitions or explosives chemistry; later, work in synthetic rubber, petroleum refining, and plastics were emphasized.

An Engineering, Science, and Management War Training course in analytical chemistry at Bryn Mawr College illustrates this program. Approximately 100 girls in all were trained in four consecutive groups. A year of high school chemistry was required for entrance to the 40-hour-a-week course which lasted 10 weeks. The first and last groups were placed in the Philadelphia Navy Yard, the second and third groups largely in war production plants in Philadelphia, with a few going into the Yard.

Reports from scattered individuals and college placement bureaus indicate that those who took such courses were satisfied with the training and the jobs they received. Apart from the satisfaction derived from performing a war service, women found them of permanent value either as an introduction to more complete training or as a supplement to a background already obtained through regular courses. For example, one young woman, after graduating in 1941 from a woman's college, did analytical chemical work for 8 months in the control laboratory of a drug company. She then took Engineering, Science, and Management War Training courses in engineering mathematics and chemical engineering and at the war's end was in charge of the analytical work on paints in a research laboratory of a chemical plant. For others, these brief courses supplied opportunity for checking through first-hand experience their aptitude for and interest in chemistry. However, the courses were not designed to offer the basic background needed by women who intend to become chemists. Women who depended on such courses to qualify them for retention in a laboratory when college graduates again became readily available were usually disillusioned.

In-service training in laboratory work was given by many plants as well as by Government agencies where the number of new workers justified a more formal program than the usual "breaking-in" of a novice by an experienced member of the staff. For example, Army Ordnance gave special chemical and metallurgical courses to women selected for laboratory work (*62*). An oil company in Texas trained college women in 4 groups of 10 each. They completed a 2-week course of 2 hours of lectures supplemented by 6 hours of laboratory practice under the supervision of expert chemists who had had teaching experience (*25*).

Regular Degree Courses.—Women, of course, were encouraged to enter regular courses leading to a degree in chemistry, which in most colleges were accelerated by eliminating or reducing vacation periods, so that a 4-year course was completed in 2½ or 3 years. In July 1942, Federal loans were made available to women as well as men who were within 2 years of completing their professional training in chemistry. So few applied for these loans, available in six other fields as well, that the program was discontinued in 1943.

By 1944, the effect of the war on the supply of degree students in chemistry was evident in the 50 percent decline in the number of undergraduate students majoring in this field. (See table 6.) The number of women had increased by only 10 percent, but their proportion to the total number had grown from less than one-fourth to almost one-half of the undergraduate students majoring in chemistry. In 1944, women who received a bachelor's degree in chemistry totaled 1,237, more than double the prewar number. At the graduate level the change was drastic. Both men and women students declined in number by about half from 1942 to 1944.

Table 6. Distribution of Men and Women Undergraduate and Graduate Students in Chemistry and of Those Receiving the Bachelor's Degree in Chemistry, 1942 and 1944

	Number		Percent		Percent change 1942–44
	1942	1944	1942	1944	
Undergraduate students:					
Total	25, 692	12, 280	100. 0	100. 0	−52. 2
Men	20, 063	6, 085	78. 1	49. 6	−69. 7
Women	5, 629	6, 195	21. 9	50. 4	+10. 1
Bachelor's degrees conferred:					
Total	4, 116	3, 711	100. 0	100. 0	−9. 8
Men	3, 281	2, 474	79. 7	66. 7	−24. 6
Women	835	1, 237	20. 3	33. 3	+48. 1
Graduate students:					
Total	3, 437	1, 722	100. 0	100. 0	−49. 9
Men	3, 045	1, 521	88. 6	88. 3	−50. 0
Women	392	201	11. 4	11. 7	−48. 7

Sources: Statistics on Students: U. S. Employment Service, National Roster of Scientific and Specialized Personnel (*51*) and (*52*).
Statistics on Degrees: U. S. Office of Education (*56*) and (*57*).

In high schools the trend was similar. In spite of the wartime emphasis on science and the increase in high school enrollments in physics, enrollments in chemistry followed the general decline in total high school enrollments that took place from 1941 to 1943. The number of girls taking high school chemistry in most types of school systems, however, increased (*16*).

Supply at the Close of the War

At the close of the war, in 1945, chemists with at least the bachelor's degree or its equivalent in experience probably numbered about 75,000. This figure was reached by adding a 4,000 allowance for additional graduates in 1944 and 1945, minus withdrawals for death or retirement, to the Bureau of Labor Statistics' estimate of 71,000 civilians employed in chemistry, exclusive of chemical engineering, at the end of 1943 (*45*). In addition, there were at least 10,000 chemists in military service and about the same number of persons with partial training or experience in chemistry below the bachelor's level. From 5,000 to 6,000 of all chemists were women, who formed more than 6 percent of the total in 1945, as compared with 3 percent before the war.

Although the statistical evidence of the increased opportunity for women chemists in wartime and the resulting increase in their numbers is convincing, many women chemists warned against over-enthusiasm. One woman chemist called attention to the prejudice which she asserted continued to exist. Another commented on the high earnings in war industries, but warned that the work was routine and offered little opportunity to learn. She said, "Your employer regards you as something he picked up on the bargain table; and your men associates regard you as an intruder in their domain" (*65*). A number questioned the "wonderful opportunities" resulting from the war, observing that these opportunities were chiefly in control laboratories and that few women were given greater opportunity to do original research.

Earnings, Hours, and Advancement

Earnings

The war did not remove the differences in the earnings of men and women chemists. They persisted in spite of salary increases. The disparity that existed before the war was evidenced in a report of the American Chemical Society. In 1941 the median earnings of women who were regular members of the Society and had 5 years of experience in the profession were $1,776 a year ($148 a month), as compared with a median of $2,328 a year ($194 a month) for male members with comparable length of experience. The highest average for women members was among those with 32 to 36 years of experience, for whom the median was $3,960 a year ($330 a month), as compared with $5,364 a year ($447 a month) for men of comparable experience (*2*).

A similar study at the end of 1943 showed the wartime increase in earnings. The lowest median base salary for women in 1943 was $1,884 a year ($157 a month) for beginners, higher than the 1941 median for women with 5 years of experience. The highest was $4,512 per year ($376 a month) for women with 38½ years of experience. The earnings of men had also increased. The median for men beginners exceeded that of women without experience by $192 a year ($16 per month). The differential between the medians for men and women increased with length of experience until it reached $1,980 a year ($165 a month) in the group with 28½ years of experience (*3*).

The 1943 median income (including overtime fees and bonuses) for all chemists, regardless of experience and including members and nonmembers of the American Chemical Society, was $3,280 a year ($273 a month) according to the Bureau of Labor Statistics. The median base salary without overtime pay was $2,916 a year ($243 a month). The comparable median base salary rate for all women chemists was $2,040 ($170 a month).

Earnings varied not only with sex and with length of experience but with education and type of work. Chemists with doctor's degrees had a median base salary in 1943 that was $1,032 a year ($86 a month) higher than that of chemists with bachelor's degrees. Administrative posts paid best, with a median of $4,020 a year; and secondary school teaching and analysis and testing paid the least, with medians of $2,616 and $2,520 respectively (*45*).

Although openings for women chemists dropped off at the end of the war, reports from those placing college graduates indicate that beginning salaries which had increased during the war were not lowered. Most industrial laboratory jobs as well as technical library or secretarial work for recent college graduates were offered in 1946 at salaries ranging from $1,560 to $2,080 a year ($130 to $175 a month). A few paid as high as $2,300 to $2,400 ($192 to $200 a month). Holders of a master's degree were usually started at $300 a year more; those with a doctor's, at $1,000 a year more than those with only the bachelor's degree. On the west coast two chemical companies were paying women technicians the same salaries as men, ranging from $2,076 to $3,468 a year ($173 to $284 a month). Women chemists with 5 to 10 years of experience were earning $3,000 to $3,500 a year ($250 to $292 a month). The Federal salary at the beginning professional level in chemistry in 1947 was $2,644 ($220 a month). (For minimum requirements see p. 2–55.) The highest possible maximum for chemists in the Federal service was $9,975 ($831 a month).

Hospitals were offering the new graduate up to $2,000 ($167 a month), although $1,500 to $1,800 ($125 to $150 a month) was more usual and $1,200 ($100 a month) not uncommon. Research projects in medical schools, colleges, and research institutions varied widely in offerings depending upon the financing of the project or programs; $1,500 to $2,700 was the usual range for those with the bachelor's degree.

College teaching assistantships (usually half-time) at $800 and $1,000 ($89 to $111 a month for an academic year of 9 months) and instructorships open to women were still hard to fill with well qualified persons. The American Chemical Society reported the same salary range for chemistry faculty positions in 1944 as for 1939: instructors began at $1,800 to $2,500 ($200 to $278 a month for 9 months); teachers with 10 years' experience received $3,000 to $5,000 ($333 to $556 a month for 9 months), and top salaries ranged from $4,000 to $10,000 ($444 to $1,111 a month for 9 months) (*5*) (*4*). The median salary for high school teachers in 1946–47 was $3,594 in cities over 100,000 ($359 a month for 10 months) and $2,774 ($277 a month for 10 months) in cities of 30,000 to 100,000, an increase of some $700 over the prewar median (*33*).

An analysis of the income of chemists over a period extending from 1926 to 1943 indicates that the "real earnings of the younger chemists with less experience have increased markedly in recent years, while the older chemists have gained little in real earnings" (*24*). Scattered reports on earnings obtained incidentally in the Women's Bureau study support the application of this statement to women chemists.

Hours

The hours of chemists vary with their type of employment. Chemistry teachers, for example, have schedules comparable to those of other teachers. Those doing routine testing in public health and other medical laboratories have regular hours and a week ranging from 40 to 48 hours. In industrial and research laboratories of all types, hours vary more widely, because some control and research work requires constant, 24-hour attention. In such cases, chemists in the laboratory usually work on 8-hour shifts. During the war, when factories were in constant operation, shift work in laboratories increased. Most women did not want night work, and most employers were reluctant to employ them on the night shift, even though legislative restrictions on their employment at night were generally waived as a war measure. Most laboratory work, however, does not require 24-hour attention, and regular hours are scheduled.

Advancement

If advancement is measured in terms of earnings, technical administrative posts, such as those of directors of research and of laboratory directors, represent the top. Chemists in these positions are by far the highest-paid group. That a few women attain such posts is evident from the 1943 distribution of women chemists which showed 5 percent of them in this type of work. The fact that 15 percent of the men chemists were technical administrators indicates that women are less likely than men to advance to such positions (*45*).

Women chemists in administrative work located by the Women's Bureau were for the most part directors or assistant directors of chemical laboratories or division chiefs. Others in supervisory positions were section heads or "group leaders" (supervising a team of chemists and assistants on a particular research project or type of analysis). One, however, was technical director for both laboratory and plant in a chemical firm in the Middle West. Another was an assistant bureau chief in the Federal Government.

Alumnae reports from the colleges show that women chemists are serving in small numbers as directors of research in industrial establishments and as heads of chemical laboratories in some hospitals and health research centers. A few women administer their own businesses as consulting chemists. The first woman to become a consulting chemist 30 years ago applied her metallurgical and gemology training to problems of jewelry manufacturing (*64*). Refrigeration chemistry,

Courtesy University of Cincinnat

Figure 7.—An analytical research chemist performs an experiment relative to the development of an analytical method to be used in an industrial laboratory.

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paper chemistry, and cosmetics chemistry are other fields in which outstanding women have succeeded as consultants.

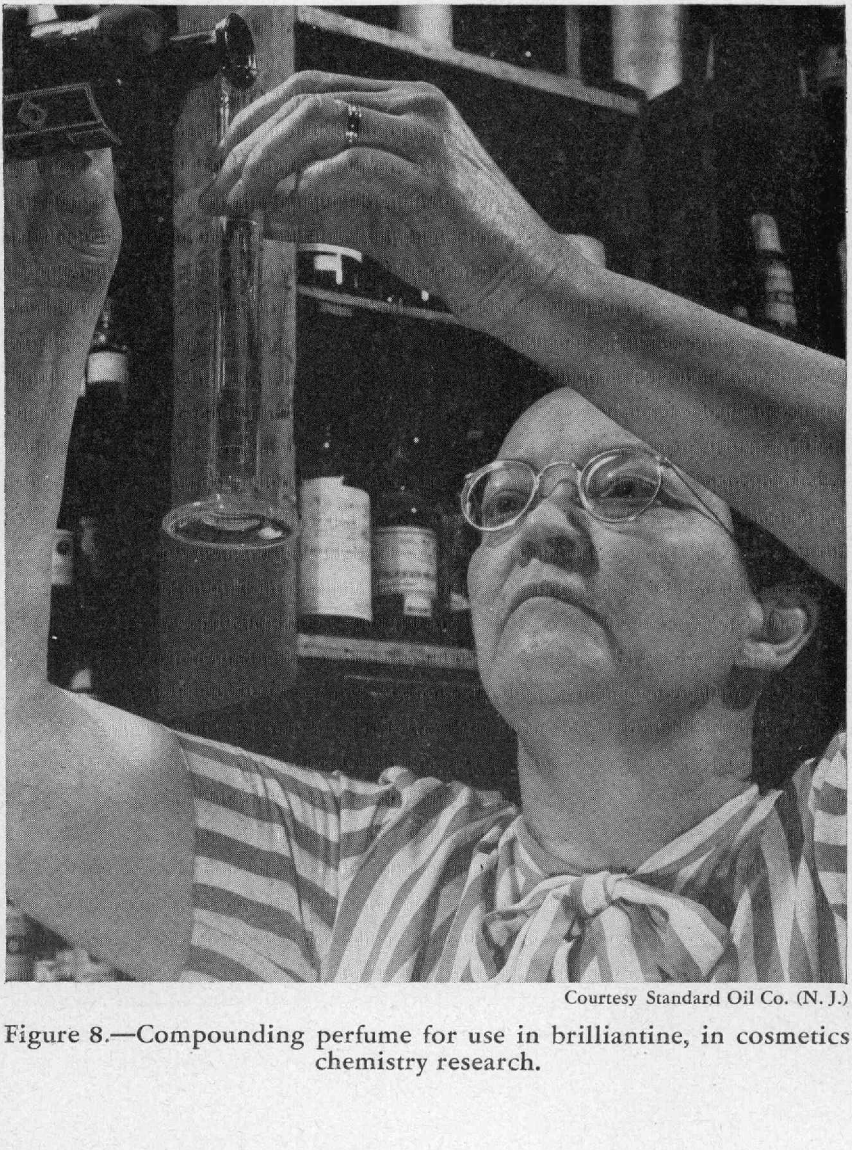
The research chemist ranks next to the administrator in earnings (*45*). The woman with a Ph. D. in chemistry who does not go into teaching is likely to become a research chemist. As such, she will probably have a small laboratory of her own in which to carry on independent research, with perhaps one or two assistants. Or she may be assigned to assist someone even more highly trained, on certain aspects of a research problem. Her advancement is measured in terms of earnings and depends on her ability to produce results. Openings for such work for women in the past have been relatively greater in research institutions and colleges than in industrial research.

In college teaching, advancement is evidenced by higher rank and increased salary. Although a Women's Bureau study of 330 college catalogs revealed that the majority of women chemists on college faculties have not attained a rank higher than that of instructor, 14 women in 1946 had reached the rank of full professor in chemistry, and 41 others were associate or assistant professors in these colleges, which, according to the United States Office of Education, were representative in their enrollment of the 1,749 institutions of higher education in the United States. At least one woman has become president of a woman's college after serving on the chemistry faculty.

This evidence that women can and do advance to posts of responsibility in industry and Government and in educational and research institutions does not contradict the fact that although their range of jobs is wide, women tend to be concentrated in the lower-level positions. In the Federal Government, for example, the majority are found at the two lowest professional levels, called "P–1" and "P–2." Only in the Patent Office were there as many women chemists at the P–4 and P–5 levels as at P–1 and P–2. However, in all the agencies combined they ranged through all grades up to P–7. No women chemists were in the two highest grades of P–8 and P–9. In industry, although again the range was great, concentration was at the lower levels. The technicians, research assistants, and laboratory assistants outnumbered by far those who qualified fully as chemists.

The higher turn-over among women is usually given as the major reason for their relative lack of advancement. That "men don't like to work under a woman" was given as a reason for not promoting women to group leader or other supervisory positions. However, where women were found in supervisory positions involving men in industry, Government, and research institutions, the results were reported to be satisfactory. Enough women were found in top administrative jobs involving supervision of both men and women in so-called men's fields such as sanitary control and rust prevention to indicate that such prejudice is not inevitable and can be overcome. Their success, of course, indicates the ability to get along with people and willingness to accept responsibility as well as ability to handle the job itself.

In industry, the possible channels of advancement are more numerous for men than for women, and this is given as another principal reason for the slower advancement of women. Only a few of the men chemists remain in the central laboratory of a chemical manufacturing firm, for example, for more than 5 or 6 years. These few are those interested in and qualified (by graduate training usually) for research. The others are dispersed to the plants, where they may ultimately become plant



Courtesy Standard Oil Co. (N. J.)

Figure 8.—Compounding perfume for use in brilliantine, in cosmetics chemistry research.

superintendents, or to the sales department, where their technical knowledge is utilized in sales promotion or selling. Some may be trained to purchase raw materials or to assist in the selection of personnel. A woman chemist, on the other hand, is seldom channeled out of the laboratory as a prospective candidate for such plant, sales, purchasing, or personnel work. Even in such industries as cosmetics and foods, where her sex might be considered an advantage, she is seldom considered as a potential candidate for sales openings unless she herself has the drive to suggest the idea and convince the management of its soundness. If she remains in the laboratory, her advancement depends largely upon the amount of her graduate training and upon her personal adjustment to the unique environment of the laboratory in which she works. The attitude of the head of the laboratory, as well as her own, is an important factor in easing or making more difficult her acceptance as a chemist rather than as a woman.

Organizations

The principal organization of chemists and one of the largest single professional organizations of scientists is the American Chemical Society. Founded in 1876, by the end of 1946 it had grown to approximately 48,000 members, of whom 6 percent or almost 3,000 were women. (See p. 2–55 for membership requirements.) About one-fourth of all members are chemical engineers or workers in related fields, but only a few of the women are engineers. In 1943, for example, there were only 13 (*3*). A higher proportion of those with graduate training are found in the society than among chemists generally. In 1943, 30 percent of the nonengineering members of the American Chemical Society had the bachelor's degree only, while 43 percent had the doctorate (*3*).

Although women attend all the regular meetings of the American Chemical Society, the Women's Service Committee of the American Chemical Society arranges one or more sessions of special interest to women chemists attending the annual meetings of the Society, at which the Garvan Medal is awarded annually to an American-born woman chemist in recognition of distinguished service to chemistry (*9*).

Although no woman has ever served as an officer of the national organization, women have served on the Council of the American Chemical Society and as chairmen of sections, for example in Detroit and the Connecticut Valley. The chairman of the important New York Section of the Society in 1946 was the first woman to serve in that capacity in that Section. In the Chicago Section of the Society, which has about 160 women members, a woman was on the board of directors in 1946, and a number were serving on committees. This is also true of the Northeastern Section.

The Society includes a large majority of the college teachers of chemistry but very few secondary school teachers. The latter usually belong to such teachers' organizations as the National Science Teachers' Association, or the New England Association of Chemistry Teachers, or the Central Association of Science and Mathematics Teachers.

The American Institute of Chemists, the American Society of Biological Chemists, the American Institute of Nutrition, the Association of Consulting Chemists and Chemical Engineers, the American Association of Textile Chemists and Colorists, the Association of Vitamin Chemists, the Society of Chemical Industry, the Electrochemical Society, and the Association of Official Agricultural Chemists are among the numerous national organizations to which chemists who qualify may belong. The American Society of Biological Chemists has the largest number of women members. Iota Sigma Pi, composed of women students and faculty members in the field of chemistry, was organized before World War I and in 1942 had 2,600 members.

Statistics on the number of men and women chemists who are members of the Technical and Scientific Division of the United Office and Professional Workers of the Congress of Industrial Organizations are not available, but at least three women chemists and one woman biochemist were affiliated with the Washington, D. C., chapter of this union in 1946. In March 1942, the National Labor Relations Board ruled in connection with a case involving the forerunner of that group, the International Federation of Architects, Engineers, Chemists, and Technicians, that professional employees should not be forced into a bargaining unit composed of skilled and unskilled workers as well as professional workers (*37*). Union membership, then, on the part of chemists is optional, no matter where they are employed, and in 1947 it was believed to be small compared with the number of members in professional societies.

Early Postwar Employment

More than a year following VJ-day, indications were that the number of women chemists had more than tripled as compared with 1940, and that their proportion among all chemists had doubled. At the end of 1946, 6 percent of the members of the American Chemical Society and almost 7 percent of the chemists registered with the National Roster of Scientific and Specialized Personnel were women (*50*). Although a decrease in the employment of women chemists in industry and Government took place as the demands of war ceased, and the new recruiting of additional women practically ceased, the decline in the employment of women in chemistry was relatively small leaving a large net increase over the prewar years.

Industry

Seventy-two of the industrial establishments covered by the Women's Bureau, for example, employed college women in chemical laboratory work following the war, as compared with 83 during the war, and 42 before the war. This was about 10 percent below the war peak but a 70 percent increase over 1941. Commercial testing laboratories and aircraft plants were the two types of firms in which the decrease was most marked.

In addition to the decline in numbers represented by the 11 firms which following the war no longer employed women trained in college chemistry, almost half, 32, of the firms that continued to employ women had fewer on their pay rolls than they had had at the war peak. However, for the establishments where exact comparisons were possible, the drop from the war peak was less than 10 in all cases. On the other hand, 8 firms, most of them manufacturers of drugs or other chemicals, employed more college women trained in chemistry than they had during the war. All but 3 of the 72 firms employed more in the early postwar period than before the war. The size of the increase, like the volume of the decline from the war peak, however, could not be measured exactly since complete statistics were not available.

For 68 of the 72 industrial firms employing women with college training in chemistry following the war, detailed statistics on postwar employment were obtained (table 7). Almost 900 women were employed in chemical work in these laboratories, all but 56 of them in laboratory work. An estimated 400 to 450 additional women were employed in the 4 laboratories from which separate statistics on women chemists were not available; these included two very large employers.

Table 7. Distribution, by Type of Establishment, of Women with College Training in Chemistry Employed in 68 Industrial Establishments, 1946

Type of establishment	Number of establishments	Women with college chemistry employed in chemical laboratory or related work	
		Number	Percent
Total	68	894	100.0
Chemicals	21	478	53.5
Chemicals, except drugs and medicines	14	390	43.6
Chemicals, drugs and medicines	7	88	9.9
Products of petroleum and coal	5	131	14.7
Foods	10	96	10.7
Commercial and research testing laboratories	13	53	5.9
All other	19	136	15.2

Source: Women's Bureau, 1945–46.

Almost one-fourth of those employed had some college chemistry but lacked a degree in chemistry. Of those who had degrees, about nine-tenths had the bachelor's degree only; less than 10 percent had had enough graduate work in chemistry to qualify for a doctor's or master's degree. (See table 8.)

Table 8. Educational Level of Women With College Training in Chemistry Employed in 68 Industrial Establishments, 1946

Educational level	Number	Percent
Total	894	100.0
Ph. D	22	2.5
Master's	27	3.0
Bachelor's	605	67.7
Degree held, type not specified	22	2.5
College chemistry courses but no degree in chemistry	218	24.3

Source: Women's Bureau, 1945–46.

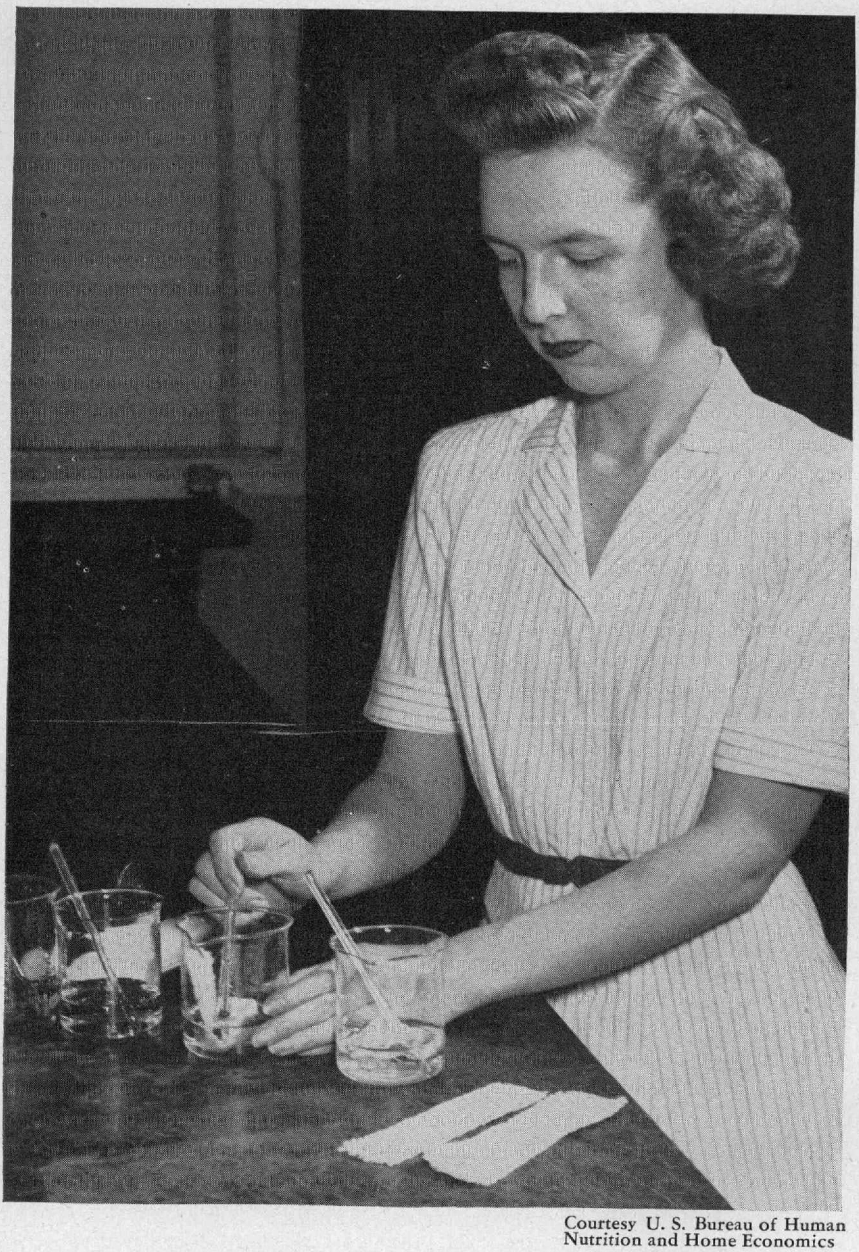
The number of different titles by which these women were called ran well over 50, including: pig iron chemist, textile technician, vitamin assayist, spectographer, microphotographer, research engineer, and junior technologist. The most common, however, was the simple title of "chemist," sometimes qualified by a letter or number, such as "chemist, grade II," to indicate differences in experience or training and in remuneration. Almost half of the women with the bachelor's degree bore this title. The next largest groups among the bachelors were "analysts," "junior chemists," and "technicians." A sizable number of those without a college degree in chemistry were also called technicians, although the most common title of those with only partial college training in chemistry was "laboratory assistant." This term was also applied to some with bachelor's degrees.

Of the 56 women in nonlaboratory work, half were technical librarians or assistant technical librarians. One-fourth were secretaries to technical officials or had other clerical titles. Patent or literature searching, editing, sales promotion, and purchasing were other categories included.

Federal Government

At the end of 1946, the employment of women chemists in the Federal Government, as in industry, was below the war peak but much higher than before the war. In none of the reporting agencies was the number of women chemists fewer than before the war.

More than 300 women with college training in chemistry were employed in 1946 in 12 separate departments or agencies from which detailed statistics were available. Three-fourths of them carried the professional civil-service title of chemist or metallurgist; the remain-



Courtesy U. S. Bureau of Human Nutrition and Home Economics

Figure 9.—Treating cotton fabric with mildew-resistant finishes.

ing number were laboratory aids or assistants. The 224 with professional titles represent the minimum number, since not all agencies were covered, and some could not supply figures on laboratories in the field.

The National Bureau of Standards and the Food and Drug Administration were the largest employers of women chemists; the War Department and the United States Department of Agriculture ranked next. The United States Public Health Service, the Patent Office, the Navy Department, the Geological Survey, the Tennessee Valley Authority, and the Bureau of Mines also employed women chemists or metallurgists, from 6 to 12 in each agency. Laboratory aids with college training in chemistry were employed in largest numbers in the War Department, Tennessee Valley Authority, and the National Bureau of Standards. Principal decreases as compared with the war peak, as might be expected, were in the Chemical Corps and Ordnance of the War Department. There was an increase, however, in the number of women chemists employed in the Food and Drug Administration because of the expansion of activities necessary to test and analyze the new antibiotic drugs such as penicillin and streptomycin.

The demand for additional chemists in the Federal service dropped off gradually following the cessation of hostilities. Examinations have been announced since the summer of 1945, but these were primarily to provide a means for those who entered Government service during the war to establish permanent civil service status. However, all the principal Government agencies employing chemists have requested the examinations, and there will undoubtedly be some appointments from the outside, probably more than during the prewar years but fewer than during the war years.

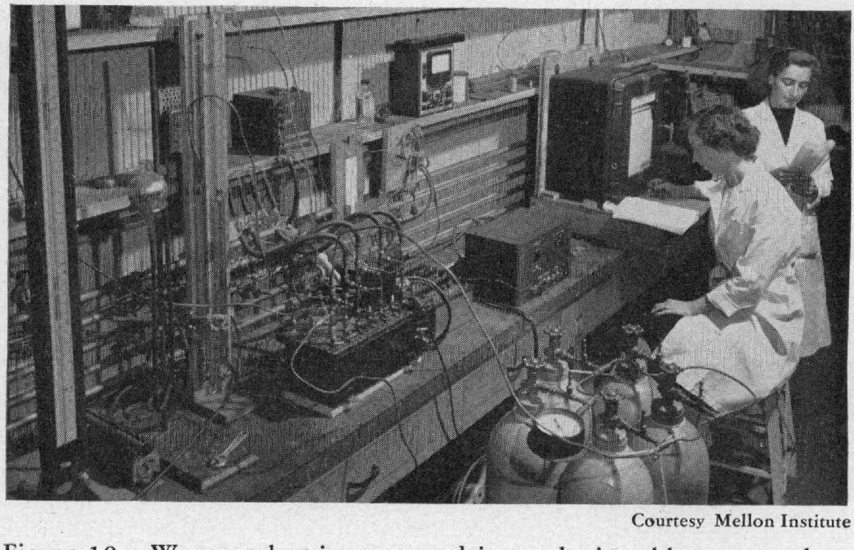
The United States Civil Service Commission early in 1947 indicated that few people besides those already employed on war service appointments were taking and passing the civil service examination. The beginning chemist or the junior professional assistant examinations are the usual channels for entering Government service as a chemist. Chemists may also possess the requirements specified in the announcements for Food and Drug Inspector and Patent Examiner. Some may also become chemists in the Government by working upward from the occupation of laboratory aid, and others may enter at higher grades.

State and Local Government

The number of women trained in college chemistry employed in local and State governments is greater than the number in the Federal service. Most of them are medical technicians in public health laboratories engaged in routine blood and other tests used in arriving at medical diagnoses, although some assist on research projects. All have at least 2 years of college, and many have a college degree in chemistry. Many have also taken special training in medical technology at a hospital school approved by the American Medical Association. Laboratory technicians in medical laboratories of all types have been discussed in an earlier Women's Bureau bulletin. In 1942, at least 50 women who were registered medical technologists were in public health laboratories (*54*). In July 1945 the United States Public Health Service found a total of 585 women employed as laboratory technicians in 38 of the States and in 80 percent of the full-time local health departments. They amounted to two-thirds of all such technicians; only one-third were men. However, only 15 percent of the full chemists employed in the same laboratories were women. They numbered 30 out of a total of 200. Altogether the women trained in college chemistry in public health laboratories, if technicians are included, may be estimated at between 700 and 800. Here, too, employment is known to be greater than before the war.

Research Institutes and Projects

In addition to the women employed in medical research in public health laboratories, there are a much greater number employed at such medical research foundations as the Rockefeller Institute and on the many research projects at medical schools and hospitals. In 1946 the Rockefeller Institute, for example, employed 43 college women who had a major or minor in chemistry, including 2 with Ph. D.'s in chemistry. Those with the bachelor's degree were technicians who assisted M. D.'s and Ph. D.'s on research projects, except for 3 who formed the publications staff of the Institute.



Courtesy Mellon Institute

Figure 10.—Women chemists engaged in synthetic rubber research at Mellon Institute.

Other research foundations such as the Carnegie Institution, the Mellon Institute, and the Batelle Memorial Institute have women chemists on their staffs. Although the Carnegie Institution in 1946 in its Department of Genetics at Cold Spring Harbor employed only 1 woman chemist and 13 women research assistants and technical assistants whose training was chemical or biological, Mellon Institute had 3 women fellows in its department of research in pure chemistry, 1 woman fellow in chemical physics, and 15 in applied science (*31*). Most of these fellows had doctor's or master's degrees. In addition, more than 100 women served as aids to the research personnel, their grade varying from those of research associate and assistant to that of technician (*31*). Batelle Memorial Institute in Columbus, Ohio, in December 1945 employed five women with bachelor's degrees in chemistry as technical laboratory assistants and seven as research engineers.

Hundreds of smaller research institutes or projects, established for the most part in connection with colleges or universities and financed by private, industrial, or government funds, employ women chemists as regular staff members or on fellowship or scholarship arrangements. The Ellen H. Richards Institute at Pennsylvania State College, named for one of the first women to achieve distinction in chemistry, for example, is engaged in the chemistry and physics of problems in foods and nutrition, textiles and clothing, and household equipment. Its work is supported by the Department of Health of the Commonwealth of Pennsylvania and other agencies of government, foundations, various trade associations, and private industry. The National Research Council in 1946 listed almost 300 colleges and universities offering research service to industry (*34*).

Although most of the wartime research projects at the University of Chicago, Columbia, and other universities which were financed by the Federal Government have been discontinued, some are proceeding on a smaller scale under the Atomic Energy Commission. Much of the peacetime technical research of the Army and Navy co-ordinated by the Joint Board for Research and Development is farmed out to colleges, including such institutions as Northwestern University, where a 2-year program of chemical research in the field of inorganic solids is financed by the Signal Corps. Although some of these research projects employ no women and others employ only a few, some of the larger ones engage a substantial number.

Teaching

Chemists differ markedly from other scientists in their type of employment because industrial employment engages so high, and teaching so relatively low, a proportion among them. In 1946, as before the war, almost two-thirds of the members of the American Chemical

Society were in industry, while one-fourth of the total were divided fairly evenly between teaching and government (*20*). In teaching, the number approached 6,000.

Among women chemists, teaching has always been a relatively important outlet especially for holders of the Ph. D. Recognition of outstanding performance seems to be achieved more readily by women chemists in teaching than in other fields. Almost two-thirds of the 82 women listed in the 1937 Chemical Who's Who were in college teaching (*26*). The wartime decrease in supply of those with advanced degrees, a shortage which is expected to last until 1950, increased the opportunities for women (*38*). A study of the catalogs of 330 institutions of higher education in the United States, included in a United States Office of Education enrollment sample, revealed approximately 400 women on chemistry faculties in the year following the war. If these institutions are as representative of the faculties in all institutions of higher education as they are of their enrollments, there were almost 1,700 women chemists on college faculties in 1946, ranging in rank from graduate assistants to full professors.

Opportunities for women in the teaching of chemistry in secondary schools continued to be much greater than before the war. Although the urgency of the wartime demand had disappeared, the specialist in science education in the United States Office of Education in 1947 believed that the long-time trend toward an increase in applied science courses in high schools is increasing women's chances for employment. Although men teachers may be available, women are more likely to be chosen, for example, to teach courses in "consumer science" or "household chemistry" than to teach a college preparatory course in chemistry.

Chemical Library and Related Work

As the volume of chemical literature has increased and as laboratories have grown, an increasing number of chemists have been employed in special libraries established by industrial, government, educational, and research organizations for the use of their personnel. Besides their usual duties of ordering and cataloging incoming books, pamphlets, and periodicals, these librarians prepare bibliographies and special summaries of published data pertaining to current problems on which the laboratory staff is working.

In a small laboratory the librarian will do all of these things and may also search for patents taken out on processes or devices related to those on which the laboratory is working. She may edit reports or publications of the staff, or do some writing herself. She may also be in charge of the technical files. However, in larger research units, there are assistant librarians as well as specialists in these related fields.

A technical clerical staff may supervise the filing and secretarial work; there may be one or more patent searchers, preferably with some legal or engineering training, to do the patent work. For the preparation of reports and publications there may be an editorial or publications staff which edits, arranges, and sometimes plans the reports and publications of the technical staff.

Between 5 and 6 percent of the women chemists found employed in industry in 1946 in the course of this study were engaged in work of this sort. More than half of these were classified as librarians or assistant librarians. One-fourth were secretaries or technical file clerks. One-eighth were on patent searching. Facility in languages along with chemical knowledge and training in the specialized techniques of the work are important on these related jobs. The caliber of this work is indicated by the fact that a good number of women holding the master's and doctor's degrees were found especially among the patent searchers and librarians. (See Bulletin 223–8 for the outlook for technical librarians.)

Postwar Demand

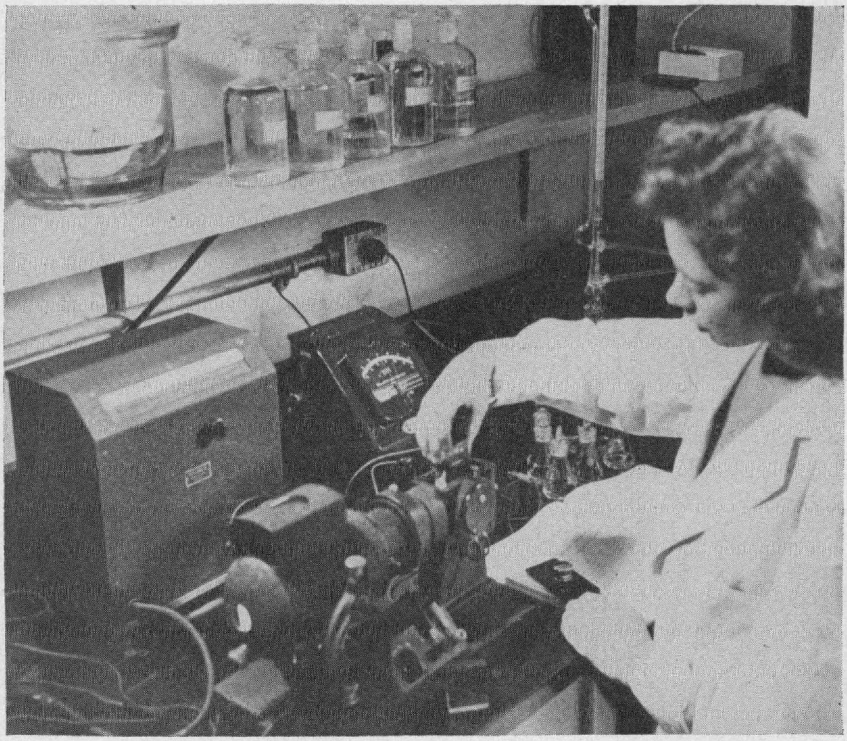
The demand for women chemists, as illustrated so spectacularly during the war, varies with the demand for men chemists. Most of the evidence indicates that the demand will increase in the long-run, after a temporary decline from the war peak. The factors contributing to the increase are as follows:

(1) Increases in industrial research, in which chemists and engineers predominate. Almost 2,500 industrial research laboratories are listed in the 1946 directory of the National Research Council as compared with 297 in 1920. More than 21,000 chemists were employed in such laboratories in 1946 (*34*).

(2) Continued growth of the principal industries in which chemists are employed, such as the chemical industries, including drugs and medicines; petroleum and coal products industries; foods industries. More than half of the executives in a recent Fortune poll indicated the chemical industry as the one which they would advise a young man looking for a start after the war to make his first choice (*22*).

(3) Greater emphasis on synthetic products in the development and manufacture of which chemistry is essential. Plastics, synthetic rubber, synthetic yarns and textiles are examples.

(4) Expansion of medical research in which chemists work with other scientists and physicians in the field of biological or physiological chemistry.



Courtesy Merck and Company

Figure 11.—Assaying streptomycin by fluorescent measurement.

(5) Increasing use of powerful drugs and medicines which require not only laboratory work in their manufacture but laboratory analyses as they are used.

(6) Increasing expenditures of the Federal Government for research on medical, industrial, agricultural, and military problems involving chemistry. In 1947, 2,700 chemists were so employed by the Federal Government (*30*). The proposed National Science Foundation would further encourage chemical research in nonprofit research organizations.

(7) Discoveries stemming from war research which encourage research into their application; new uses for radio-active substances produced as atomic fission byproducts, for example.

(8) Addition of public health laboratories at State and local levels.

(9) Growing public interest in such protective inspection of chemical products as that under the Food and Drug Administration.

(10) Increased popular interest in chemistry affecting the demand for teachers, lecturers, writers, editors.

(11) Greater enrollments in courses in chemistry in colleges, technical schools, and high schools, requiring additional instructors.

On the negative side, there are only a few factors tending to decrease the demand. These all fall under the classification of more efficient utilization of the knowledge and skills of chemists such as: the concentration of research facilities to encourage specialization and make profitable the use of better equipment; the splitting up of jobs to provide for more assistance by nonprofessional workers to those with unusual skills; and the development of a variety of mechanical devices for computing, sorting, testing, and analyzing, which save time and labor in the laboratory. However, such utilization, while it may temporarily reduce the need for additional workers, conserves the powers of the chemist for creative work, which is the well-spring of new sources of employment in the industry.

Perhaps the best barometer of the current and future demand for women recently graduated with degrees in chemistry are the schools which train them and often assist in their placement. Fifteen widely scattered colleges and universities were unanimous in their postwar comments on the demand for their women graduates in chemistry. All reported a definite drop in quantity of openings in 1947 as compared with that during the war, but indicated that all their graduates were easily placed. Although industries were not actively recruiting, girls who applied at industrial laboratories were well received and often hired. The demand for biochemists and for women for medical research was particularly active; pharmaceutical companies were among those recruiting women for beginning laboratory jobs.

An increasing number of calls for nonlaboratory placements were being received. Technical librarians, patent searchers, and chemical secretaries were being actively recruited. In 1947, teaching assistantships were still hard to fill with qualified women, although interest in graduate work was picking up, and private preparatory schools were accepting girls with only the bachelor's degree for science teaching. All reported a continuing demand for the woman with her Ph. D. As the head of the chemistry department in a midwest State university remarked, "There has always been and always will be a good demand for women Ph. D.'s especially in biological chemistry and in modern analytical chemistry."

The 1946 employment of 85 women recently graduated with the bachelor's degree in chemistry, as reported by their colleges, is contrasted in table 9 with the wartime employment of 229 women graduated during the war years and with the prewar employment of 186 women of similar background. The evidence indicates an immediate postwar increase in graduate work, corresponding roughly in percentage to the postwar decline in industrial laboratory work. However, the proportion in industrial laboratory jobs and in Federal employment was much higher than before the war. The sharp wartime decrease in the proportion entering medical laboratory work and teaching apparently had ceased. However, the proportion undertaking the study of medicine or nursing was still on the decline in the early postwar period.

Postwar Supply

The tremendous postwar increase in college enrollments makes any prediction of the supply in a particular field such as chemistry difficult, since most of the students in 1946 were veterans enrolled in beginning or survey courses who had not yet chosen a major field. Although, shortly after the end of the war, the Army education program reported that GI interest in chemistry did not appear to be very high (*21*), enrollments in chemistry increased sharply, according to the National Research Council. They did not double, however, as they did in engineering.

The number of women studying chemistry was reported to have increased proportionately, as compared with the prewar years, in all colleges on the accredited list of the American Chemical Society which replied to a questionnaire sent out by the editor of Chemical Industries. Forty-three percent said they expected this trend to continue, while 57 percent disagreed. Some believed that the trend would be reversed. Others said it would depend on employment possibilities for women (*15*). In 1946, 404 women were expected to graduate from chemistry programs accredited by the American Chemical Society. (See p. 2–56 for requirements for a degree from an accredited program.) This was almost half the total graduates of such programs and almost twice as many as in 1944. That the increase was numerical as well as proportional is likewise indicated by the marked increases in numbers of women majoring in chemistry reported by 15 of the 25 colleges from which the Women's Bureau obtained separate figures on degrees granted in chemistry to women during the years since 1939. In one west-coast university, women candidates for bachelor's degrees in chemistry in 1945 numbered 61 as compared with 28 in 1941; an eastern institution reported 21 in 1945 as compared with 6 in 1941; a southern school had 17 in 1946 and only 2 in 1941. In 10 of the institutions reporting, however, there was no noticeable change. Graduate degrees in chemistry in all institutions reporting showed little change except in one large eastern institution where 41 master's degrees were granted in 1945 as compared with 11 in 1939.

Shortages of chemists at the doctoral level, accumulated during the war, were estimated in 1945 at 790 in the report to the President of the United States by the director of the Office of Scientific Research and Development (*61*). A year after the end of the war, local draft boards were instructed to give serious consideration to requests for the occupational deferment of teachers and graduate students in the physical sciences as well as to key scientific and technical personnel in industry (*39*).

One industrial employer regarded the supply of chemists ample except for Ph. D.'s and for beginners just out of college. According to him, there has never been an oversupply of Ph. D.'s in chemistry. But lack of wartime graduates at the bachelor's level, he feels, was offset by the salvage of many chemists trained earlier who had been working in other fields during the depression.

The head of a chemistry department of a State university thinks that, "There is never a great danger of an oversupply since mathematics through calculus, physics, German, and French soon drop them out." This, of course, refers to students who take the course which meets the requirements of the American Chemical Society. Such requirements tend to limit the supply. There is also increasing competition from other growing sciences such as physics for those with the scientific mind and the academic ability required.

Future Outlook

Chemists, themselves, were optimistic about the future. When asked to give their opinions of their postwar employment prospects in the 1944 survey of the American Chemical Society, about half of them, 51 percent, anticipated no change. Forty-two percent expected to better their status. Only 7 percent thought that postwar conditions would become worse (*3*). That this optimism has been justified was indicated at the September 1946 meeting of the Society, when each of the 600 candidates seeking employment had an average of 6 or 7 interviews with employers (*36*).

A 1946 survey of the Chicago Section of the American Chemical Society by Dr. Hoylande D. Young also disclosed that a year after the war women chemists held more key positions in Chicago industry than ever before, although most of them were engaged in analytical work, in literature searching, or library work (*66*). Although they were more often in foods, health, and medical research than in other types of laboratories, women were found in every type of chemical industry from petroleum to cosmetics. Administrators, teachers, and authors were included as well as textile chemists, biochemists, food chemists, and physical chemists doing laboratory work.

Of the 72 industrial employers interviewed by the Women's Bureau for this study who were employing women chemists in 1946, 50 expected to continue to employ women in their laboratories. Eighteen expected no lay-offs but predicted that women would be replaced with men as they left voluntarily. Four anticipated lay-offs of women because of returning servicemen or reductions in staff.

As to the more distant future there is difference of opinion. Among college placement personnel, for example, some expect a continuance of the current demand which makes it relatively easy to place all women graduates and allows for a variety but not an overwhelming number of choices. Some expect an increasing demand and an increasing supply of women graduates in chemistry. Only one expected difficulty in the future in finding laboratory jobs for women graduates; another predicted that in 4 or 5 years nonlaboratory jobs would again be the chief employment outlets, except for the Ph. D. One expressed the opinion that the job break-downs in industrial laboratory work would continue, and that in the future there would be an increasing demand for girls with a minimum amount of science, high school or partial college, for example, to work under the supervision of a highly trained supervisor, thus adding to the demand at the bottom and top levels and reducing the demand for those in between. In line with this, some high schools, graduates of which were being employed by pharmaceutical firms, have established special courses in chemistry which include laboratory techniques as applied to the drug industry. A few have worked out a cooperative training program, under which school and work in the industrial laboratory are alternated. The employment of those with only high-school training outnumbered that of college women trained in chemistry in the industrial establishments visited by the Women's Bureau, but it was in the high school group that the greatest postwar decline took place. Reports from college and high-school-placement bureaus following the war indicated that the demand for girls with only high school chemistry or a little college chemistry had practically ceased. This corresponds with an earlier prediction of the American Chemical Society's employment clearing house that there would be a postwar dislocation of hundreds of poorly and partially trained chemists and technical men with only 1 or 2 years of college training (*13*). A woman chemist predicted that women with such training would become a postwar problem and "a 'menace' to the college graduate if they are considered chemists" (*17*). Adequate training is especially important for women who are a minority in this field, especially in industrial chemistry. The removal of other handicaps is also important.

Training for Women Chemists

Except in high-school teaching (where few chemistry teachers have more than 25 hours of chemistry, and a bachelor's degree in education is the common preparation) a bachelor's degree with a major in chemistry is the usual minimum amount of education required to become a chemist.

Undergraduate Training.—Most of the 4-year colleges in the United States offer either the bachelor of arts, or the bachelor of science degree, or both, with a major in chemistry. However, only 141 colleges were listed by the American Chemical Society in December 1946 as qualified to offer full professional training in chemistry. (See p. 2–56 for requirements for bachelor's degree from an approved school.) Eight women's colleges and most State and municipal universities are included on the list as well as a number of other coeducational schools (*6*).

Graduation from an approved school is preferred by most industrial and Government employers, who state that those hired with only the minimum requirement for a bachelor of arts degree in chemistry usually do not have enough background to be generally useful. One Government personnel officer, for example, says that persons appointed in normal times to beginning chemical positions usually have had 50 to 60 hours in science in their college work, although only 30 hours are required by the Civil Service Commission for application. On the other hand, one industrial employer said he preferred a bachelor of arts to a bachelor of science degree because those with the science degree tended to be too specialized, and he preferred a broader cultural background. However, there is little doubt that a large percentage of employers give preference to persons with the B. S. degree.

In addition to the wide variation in the types of schools offering degrees in chemistry and in the number and nature of the chemistry courses required for the bachelor's degree, there are fields in which specialized schools have developed: textile institutes and schools of textile technology for example. A bachelor's degree in textile chemistry is awarded at 7 schools, and a 3-year diploma course is offered at 2 additional schools (*41*). Women are admitted to most of these courses. Most women who go into the textile field, however, become interested in it through courses in schools of home economics.

A bachelor's degree from a school of home economics is not acceptable for most chemical jobs in industrial laboratories, since not enough chemistry is required, and the chemistry taken is often applied more directly to foods and textile problems than the basic courses in chemistry usually are. However, in certain types of laboratories, especially in foods and textile work, home economists are used on control work.

Courtesy U. S. Department of Agriculture

Figure 12.—A chemist in a regional research laboratory of the U. S. Department of Agriculture tests samples of treated cotton yarn.

They also do experimental or developmental work in foods, laundry, and textile products where practical knowledge combined with some chemistry is more important than advanced chemical training. In research in nutrition, textiles, foods, and some medical laboratories, there are many women with undergraduate degrees in home economics who later took their master's or doctor's degrees in chemistry. There are also women whose academic training has been entirely in the field of chemistry, who have taken special courses or obtained practical experience in home economics. There is a similar relationship in medical laboratories, where one finds women physicians, bacteriologists, medical technologists, and chemists each supplementing their background in their original field of specialization through additional courses or by experience in the other fields represented in the laboratory.

Cooperative training under which work in school and in a laboratory is alternated in a 5-year degree program is offered at a number of schools including the University of Cincinnati, Drexel Institute of Technology, Rochester Institute of Technology, and Northwestern University.

Graduate Training.—In 1934 the American Council on Education listed 67 institutions which offered the doctor's degree in chemistry (*11*). The National Roster of Scientific and Specialized Personnel's 1946 directory of colleges offering graduate degrees lists 50 as offering the doctorate in chemistry and an additional 30 as offering a doctor's degree in the physical sciences (*48*). Thirteen of the 80 do not admit women students, and 2 do not admit men. The Committee on Professional Training of the American Chemical Society was studying doctoral training in chemistry early in 1947. Information obtained by questionnaire from 76 departments of chemistry awarding the Ph. D. and from more than 550 chemists who went directly into industry after receiving their doctorates has been prepared for a report (*8*).

Graduate training in any science is expensive, not only in actual cost but in terms of the temporary loss of earning power of the student. Because the work span of the average woman is shorter than that of the average man, women, particularly, are discouraged from making so heavy an investment in the future.

Fellowships.—College teaching fellowships or "assistantships" have been the most usual method of encouraging talented young men and women to continue their study. These vary with the college which offers them but usually carry a stipend of $800 to $1,500, which the recipient earns through working halftime as an instructor or as a research assistant. The remaining time is spent in study which is generally tuition-free. Until the war, women had less chance than men of obtaining choice assistantships except at women's colleges. Only 9 percent of the 368 graduate assistantships studied by Ethel L. French in the 1939 survey, referred to earlier, were held by women (*23*). But when the war amplified their opportunity for obtaining assistantships, few women took assistantships because openings in industry and government were even more attractive. In the early postwar period, good assistantships still outnumbered well-qualified candidates, although a pick-up in interest was reported. (See also table 9.)

Several hundred undergraduate and graduate scholarships were also studied in the 1939 survey, which found that 76 percent of the undergraduate and 69 percent of the graduate fellowships were open both to men and to women (*23*). (The average money available to the student per year was $140 on an undergraduate and $407 on a graduate fellowship.) Although women held 39 percent of the undergraduate scholarships, they held only 15 percent of the graduate scholarships.

Memorial fellowships of varying amounts and fellowships awarded by industrial firms for predoctoral research, usually in a specialized field, are other forms of assistance open to the graduate student who

Table 9. Comparison of Postwar, Wartime, and Prewar Employment Reported for Some College Women Recently Graduated in Each Period With Bachelor's Degrees in Chemistry

Employment	Number			Percent		
	Postwar—1946	Wartime	Prewar	Postwar—1946	Wartime	Prewar
Total	85	229	186	100.0	100.0	100.0
Industrial laboratory	31	126	29	36.5	55.0	15.6
Graduate work, often combined with teaching or research assistantship	27	36	35	31.8	15.7	18.8
Medical laboratory	7	17	35	8.2	7.4	18.8
Research institute or college research project	7	11	6	8.2	4.8	3.2
Medical, nursing, or therapy training	4	19	33	4.7	8.3	17.8
Government, Federal	4	10	1	4.7	4.4	.5
Teaching:						
College (see also graduate work)	2	----	8	2.3	----	4.3
Other	----	4	9	----	1.8	4.8
Technical librarian	1	3	8	1.2	1.3	4.3
Non-chemical work	1	2	11	1.2	.9	5.9
Military service	1	1	----	1.2	.4	----
Museum	----	----	1	----	----	.6
Secretary	----	----	6	----	----	3.2
Writer or assistant editor	----	----	4	----	----	2.2

Source: Women's Bureau, 1945–46.

wants to obtain a doctorate. In 1946, a National Research Council's listing showed that more than 300 companies were financing approximately 1,800 fellowships, scholarships, or grants for research, with chemistry ranking first as a subject field (*28*). Often the awarding of the industrial fellowship is left entirely to the institution at which the research is carried on, and the sex of applicants is not specified. Approval by the donor is sometimes provided for, following initial selection by the university. Fifteen of the duPont de Nemours fellowships in chemistry have been awarded to women since 1943, when women were first made eligible under the program which originated in 1918. These provide $1,200 a year for each recipient of a graduate fellowship who is single and $3,000 a year for a single postdoctoral fellow (*19*). Women have also held fellowships of the American Viscose Co. and of many other corporations.

Sixty predoctoral fellowships have been made available by the American Chemical Society to chemists "whose training was interrupted by the war." No women were among the 60 to whom awards were made in 1946–47, although they are eligible. The fact that there is a need for this sort of assistance was shown by the 568 applications received for the 60 fellowships (*10*). Five of the 190 postdoctoral fellowships in chemistry awarded by the National Research Council from 1919 to 1938 went to women (*35*).

In 1947, financial aid through fellowships or assistantships was easily available at the graduate level to outstanding candidates. The war period, during which there were few candidates, enabled the colleges to accumulate reserves to serve as a bulwark against later needs. Women should avail themselves of these and other opportunities to obtain the maximum training possible, if they are to supply the leadership and make the contributions to chemistry that so far only a few have made. They also need to overcome some of the other handicaps that face them in this field of work.

Some Handicaps

Higher turn-over among the women was given by most of the employers of chemists interviewed by a representative of the Women's Bureau as their chief criticism of women chemists. "When they marry and leave us, our investment is lost," said one. In a West Virginia control laboratory where 12 women just graduated from college with degrees in chemistry were placed in 1942, 9 left by the end of the first year, 6 of them to marry men in the laboratory. Although this took place during the abnormal war period, it was described by one employer as an illustration of an ever-present problem.

A personnel director of a chemical company, having been asked many times by women chemists who applied for work during the war period, "Is the work permanent?", once countered, "Are *you* permanent?" The applicant became somewhat flustered, admitting she was engaged to be married as soon as her fiancé would be released from military service. His whereabouts would determine whether or not she could remain with the company following her marriage. This aura of impermanence which surrounds many women applicants may not interfere with, in fact it may encourage, their employment on jobs that are likely to become tiresome and on which a high turn-over is expected. But, it definitely handicaps women in obtaining jobs of responsibility on which continuous service is expected.

The woman with the Ph. D. is more often able to rid herself of this initial handicap because she has already made a considerable investment of her own in chemistry and is more likely to remain in the field. However, the majority of women chemists are not Ph. D.'s, and the responsibility for progress in this field lies with the bachelor's degree group. Some suggestions as to what can be done along this line are given on page 2–51.

Insufficient notice on leaving and requests for time off without consideration for the work of others were the chief criticisms given by employers about the women employed in the laboratory, particularly the younger ones. The abnormalities of the war period undoubtedly both caused and exaggerated faults of this kind, but their continuance in peacetime on the part of a few handicap other women in employment and promotion.

The nature or location of the work is sometimes given as a reason for not employing more women. A chemical employer says, "Our laboratory men have to climb into tank cars and get samples and we don't like to have women doing that." The United States Bureau of Mines, although it employs some women, reports that the laboratory men must go underground often and that much of the work is rugged and arduous. One oil company prefers laboratory men who are available for travel to rough and remote places, in other countries if necessary; another indicates that its plants are, for the most part, in isolated places, where women would not choose to work. Only one director mentioned that the work in the laboratory was too heavy for a woman, since the containers from which samples were taken had to be handled by the laboratory men.

Obviously, many of these reasons disappear if the laboratory itself is large enough for some specialization. As one director of research put it: "In a larger laboratory where jobs are broken down, contacts are within the division rather than with the sales department or the plant and one doesn't have to sling a wrench."

The obtaining of plant samples by chemists in industries in which the plant workers are usually all men, as in dye works, tanneries, paper mills, heavy chemicals, etc., is not an insurmountable handicap to the employment of women. The wartime use of women in shipyards and steel mills indicated that men in the plant accustom themselves quickly to the presence of women in the plant. But it is easier for a woman who has had actual plant experience, engineering training, or comparable practical experience to handle the plant aspects under such conditions without self-consciousness.

The attitudes of men workers in the laboratory were also mentioned as a handicap to women chemists. Some employers reported: "The men don't like to have girls in the laboratory." However, the majority of the laboratory directors said that men and women worked well together. In one Government laboratory the men at first objected to the introduction of women during the war, but later their initial fears were soon forgotten. One head of laboratories in a drug company prefers a mixed laboratory where women and men complement each other. He says that women are more practical, neater in workmanship, not as bored with routine; that men are better housekeepers and better at the higher level jobs. One or two reported that the appearance of the laboratory and of the men had improved with the introduction of women.

Scattered comments on differences between men and women chemists were as follows:

Men are more temperamentally suited to the failure of tests, take their failures more objectively.

Women are not as imaginative and eager to do something new. They are less likely to present new ideas and when they do, are more likely to take a rejection of it personally.

Women are better than men on research involving extensive data-keeping and are more reliable, also, on routine tests.

Although women in general are believed to be more dexterous, the head of one of the principal Government laboratories says that women

Courtesy E. I. DuPont de Nemours Company

Figure 13.—Fine manipulations are required in a chemical laboratory. This college graduate weighs powder on delicate scales in a control laboratory.

are not as good at fine manipulations because they need training in laboratory mechanics. However, once they are trained, they always use the right tool.

The more varied choice of positions for men chemists, already mentioned earlier, and the fact that most of the women wanted to work within 25 to 50 miles of their homes are other reasons given for the relatively small numbers of women chemists in laboratory work.

The tendency for women to seek work near their homes limits their chances for employment, since opportunities are not equally good in all parts of the United States. How much of this preference is prompted by choice, how much by necessity is not known. But other studies of the Women's Bureau indicate that the responsibilities of single as well as married women for financial aid or for services to the other members of their families are considerable, often resulting in a lack of mobility which limits the individual's choice of jobs and makes her a less desirable employee on jobs where travel or transfer may be involved.

Some types of chemical work, of course, are done in every large community. Hospitals, medical schools, and public health laboratories, as well as such ubiquitous industries as dairies and bakeries employ chemists. However, quantitatively, because of the concentration of large manufacturing industries, there are greater opportunities in some parts of the country than in others.

Before the war, according to the Census, almost three-fourths of all chemists were employed in the Northeastern or North Central States; the South ranked third and the West last.[1] The proportion of women among chemists in the various sections of the country was highest in the Northeastern States and lowest in the South (*44*). (See table 10.)

This prewar concentration of employment opportunities for chemists in the Northeastern and North Central States is confirmed in the 1944 study of the Bureau of Labor Statistics. This study showed almost the same proportion (40.4 percent) of chemists in the Northeastern States as did the 1940 Census. The South's percentage was 3 percent higher than before, 20.1 percent. The proportion in the North Central States had declined to 29.4 percent and in the Western States

[1] The regions as designated in the Census are as follows:

Northeastern States—Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont;

North Central States—Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin;

South—Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia;

West—Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming.

to 9.1 percent. The State of New York alone employed 13.5 percent of all chemists, Pennsylvania, New Jersey, and Illinois ranking next (*44*) (*45*).

Table 10. Distribution of Employed Chemists, Assayers, and Metallurgists, by Region and Sex, 1940

Region	Number			Distribution of total	Percent women are of total
	Total	Men	Women		
The United States	57,025	55,371	1,654	100.0	2.9
Northeastern States	23,287	22,472	815	40.9	3.5
North Central States	17,792	17,324	468	31.2	2.6
South	9,767	9,547	220	17.1	2.3
West	6,179	6,028	151	10.8	2.4

Source: U. S. Census (*44*).

Suggestions for Young Women Who Want to Become Chemists

In any occupation, one finds optimists, pessimists, and the realists whose experience and temperament enable them to evaluate the advantages in relation to the disadvantages. Because chemistry has been in the main a man's field, there are those who say, as one head of a chemistry department in a State college has—

> Advise girls interested in chemistry to stay out. But if they insist, advise them to prepare for a field in which women have an advantage rather than a handicap.

According to this advice, only the girl with a driving interest, combined presumably with ability in chemistry, should be encouraged to become a chemist, and she should be steered toward foods, textile, or cosmetics chemistry; biochemistry; analytical chemistry; or toward work as a technical librarian, patent searcher, or technical secretary. Spectroscopy and microchemistry are more recently emerging specialties in which women have an advantage.

A woman chemist, on the other hand, wrote optimistically in 1945:

> The woman who enters the industrial chemical field today has just as much assurance as a man of obtaining profitable and interesting employment. Her career will be determined by the quality of her initiative and courage.

The majority of the employers, college representatives, and women chemists interviewed in connection with this study predicted a steadily increasing and widening opportunity for women chemists but stressed the importance of being well-qualified. By well-qualified they meant better qualified than a man would need to be for the identical job, in order to offset the handicaps already discussed. The basic qualifications for success in chemistry are fully described in publications of the National Roster of Scientific and Specialized Personnel (*47*) and of the American Chemical Society (*5*). Only those mentioned as being especially important for women, therefore, are included in this bulletin.

The head of an important Government laboratory said that, if he were advising his daughter to prepare for work as a chemist, he would tell her that she:

> must attain manual dexterity in handling equipment equivalent to the standards of men;
> must learn to look at a problem in its broadest aspect;
> must learn the habit of hard work in absorbing and thinking through concepts and formulae.

Two employers, one in Government and one in industry, likened the good chemist to a good cook. Imagination, the use of a variety of ingredients, exactness, the ability to keep many pots cooking at the same time, resourcefulness—all these are needed by cooks and chemists. The cook who lets the stew burn while she talks to her neighbor is like the chemist who can't set up and control more than one experiment at a time.

Women chemists almost all mentioned the desirable traits of cooperativeness, adaptability, and a serious attitude toward one's job as ranking equal in importance to training and experience not only in obtaining employment for oneself but in smoothing the path of those who come after.

A woman should not seek a research or other responsible job, if she does not intend to work for more than two or three years. On the other hand, if she is interested in chemistry as a career and intends to keep up with it come what may, she should give evidence of this interest through further study, through participation in professional organizations, through discussion with colleagues, through writing. Only in this way can she counteract the erroneous notion that all men show a more serious attitude toward their work than do all women. Whether she falls in the short-run or long-run interest group, she should maintain certain ethics in relation to her work.

The three women who left a laboratory in a foods company one after another after only a few months of service have closed that position to women as long as the present head of the laboratory is in charge. The technical secretary who left a metal products company without notice to take a 3-months' trip with her husband on his return from military service left in the laboratory a resentment that will affect the chances of women not only in her former job, but throughout the laboratory. Two women chemists who left a testing laboratory with only a few days' notice in 1945 were replaced by men, although the head of the laboratory was a woman. Women in scientific work must recognize the obligation not only to perform the job well but to accept the responsibilities that go with such employment.

Regarding training, a number of suggestions were made. Many employers commented that most women applicants didn't have enough courses in chemistry. Women chemists and placement directors stressed the need for more mathematics and physics along with chemistry. Training in report-writing and in oral reporting was recommended. Typewriting and stenographic skills were also suggested as being useful on laboratory as well as nonlaboratory jobs. For research, for technical library work, or for literature searching, German, French, and Russian were mentioned as desirable languages.

One woman urged a knowledge of engineering subjects for those who plan to go into industrial laboratories because of their need for understanding of processes. A director of research of a large foods company advised:

> Teach them what industry requires. Those from small colleges especially have no idea of industrial processes or what industry is about.

Another aspect of this gulf between college training and the job in industry or Government is illustrated by a placement director who reported difficulty in placing in industry young women graduating with the bachelor's degree in chemistry who want to do research but don't want to do factory or routine work first. She noted, however, that those who have had contact with industry have a different attitude. A girl, for example, whose uncle was director of research in an oil company willingly started on a calculating job as part of the learning process. Obviously, visits to the type of laboratory in which one may wish some day to work, talks with women chemists, and, better still, some actual work experience in various types of chemist-employing establishments will help to bridge the gap between textbook and practice that the engineer is compelled to bridge to qualify for his engineering degree. A few laboratories employ women during the summer months when vacations temporarily reduce their regular staff, offering an opportunity for a try-out both to the college women and the firm.

The increased enrollments of women in chemistry in the war years has shown that there is a potential supply of women who will become chemists, if the opportunities for employment are encouraging. They also indicated, however, that these opportunities have not been great enough to induce many girls, as compared with boys, to consider chemistry at an early age as a possible career. One prominent woman chemist attributes the small number of women with doctorates to the fact that some professors discourage women, because they are afraid they cannot place them. Even more serious is the diversion that takes place in the high school, when the average daughter is discouraged from taking mathematics, physics, and chemistry, while the son is customarily urged to do so. The chemical set under the Christmas tree invariably goes to the boy in the family, although later the girl may be found to enjoy it as well. Girls, then, and young women, later, need full opportunity to demonstrate and to develop their interest, if we are ever to know to what extent the small number of women in chemistry is due to biological factors and how much it is influenced by environment and custom. Meanwhile, there is room for more women in chemistry, that is, women who can be truly described as "well-qualified."

APPENDIX

Minimum Education and Experience Requirements for Application for Beginning Federal Civil Service Position as Junior Professional Assistant With Option in Chemistry ($2,644 a Year)

(As taken from Civil Service Announcement No. 75, issued October 14, 1947, closed November 4, 1947) [1]

Applicants must have successfully completed *one* of the following:

A. A full 4-year course, in a college or university of recognized standing, leading to a bachelor's degree in chemistry. This study must have included courses in chemistry consisting of lectures, recitations, and appropriate practical laboratory work totaling at least 30 semester hours; *or*

B. Courses in chemistry, in a college or university of recognized standing, consisting of lectures, recitations and appropriate practical laboratory work totaling at least 30 semester hours; plus additional appropriate experience or education which, when combined with the 30 semester hours in chemistry, will total 4 years of education and experience and give the applicant the substantial equivalent of a 4-year college course.

In either A or B above, the courses must have included analytical chemistry, both quantitative and qualitative, and in addition, any two of the following: (*a*) Advanced inorganic chemistry; (*b*) biochemistry; (*c*) organic chemistry; (*d*) physical chemistry.

Requirements for Membership in the American Chemical Society (*1*)

Full Membership.—An adequate collegiate training in chemistry or chemical engineering, or its equivalent, and 5 years of graduate training or experience in some form of chemical work. Only 2 years of postgraduate study or experience are required from those who have studied in a department of chemistry or chemical engineering accredited by the ACS and who have been certified by the head of the department as having completed the course recommended by the society.

Junior Membership.—Adequate basic training but insufficient graduate study and/or experience for member, senior grade, or inadequate training but engaged in chemical work.

[1] For more complete and later information, consult latest announcements of the Civil Service Commission posted in first-and second-class post offices.

Minimum Requirements for Bachelor's Degree in Chemistry From a School Approved by the American Chemical Society

The minimum course requirements in chemistry for the bachelor's degree consist of four basic year courses in general chemistry (which may include qualitative analysis), analytical chemistry, physical chemistry, and organic chemistry, together with at least one advanced course. These courses must meet the following general requirements:

1. General chemistry[1] which may include qualitative analysis (30 weeks including three lecture or recitation hours and four to six laboratory hours weekly).

2. Quantitative analysis (30 weeks, including not less than 8 hours a week of which 2 will be devoted to discussion of principles—should include some training in qualitative analysis, if not covered in another course).

3. Physical chemistry[2] (30 weeks, including three lecture or recitation hours and three laboratory hours weekly).

4. Organic chemistry (30 weeks, three lecture or recitation hours and five to six laboratory hours weekly—must include organic preparations work and should include qualitative organic analysis unless special course in that offered).

5. Advanced chemistry[3] (30 weeks, including two lecture or recitation hours and three to four laboratory hours for 15 weeks. May be in: inorganic, analytical, physical, organic chemistry, or biochemistry).

The minimum training for professional chemists must also include the following:

1. Physics—at least one year (30 weeks including three lecture or recitation hours and three laboratory hours weekly).

2. Mathematics—2 years of college work (including 1 year of differential and integral calculus).

3. Foreign languages—a reading knowledge of scientific German is required. Russian or French is advised as a second language.

4. English composition—1 year (including writing of some technical papers or reports).

5. Humanities—at least the equivalent of one-half year's study in subjects in fields other than those prescribed.

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[1] High-school algebra and geometry are prerequisites.

[2] Quantitative analysis, a year of general physics, and a year of differential and integral calculus are prerequisites.

[3] Three years of chemistry prerequisite.

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