Manpower Resources in Chemistry and Chemical Engineering

Bulletin No. 1132

UNITED STATES DEPARTMENT OF LABOR

BUREAU OF LABOR STATISTICS

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LETTER OF TRANSMITTAL

United States Department of Labor,
Bureau of Labor Statistics,
Washington, D. C., February 1, 1953.

The Secretary of Labor:

I have the honor to transmit herewith a report on manpower resources in chemistry and chemical engineering. The study is based on data obtained through the registration program for chemists and chemical engineers conducted in 1951 by the National Scientific Register, James C. O'Brien, Director. The Register was at that time in the U. S. Office of Education, Federal Security Agency; on January 1953 the functions of the Register were taken over by the National Science Foundation. The American Chemical Society handled the mailing of the survey questionnaires to its membership and to an extensive list of qualified [nonmembers] compiled by the Society's local sections.

This report was prepared in the Bureau's Division of Manpower and Employment Statistics in cooperation with the National Scientific Register. It was planned and written by Laure M. Sharp and Theresa R. Shapiro under the supervision of Helen Wood. Dr. B. R. Stanerson, Secretary, Committee on Manpower, American Chemical Society, and Stephen L. Tyler, Executive Secretary, American Institute of Chemical Engineers, served as technical consultants in reviewing the manuscript.

Ewan Clague, Commissioner.

Hon. Martin P. Durkin,
Secretary of Labor.

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INTRODUCTION

Chemistry and chemical engineering are two of the fastest-growing professions in the United States. In 1951, there were close to 150,000 chemists and chemical engineers in the country, nearly twice as many as in 1940. The industries which are the chief employers of chemists and chemical engineers expanded greatly during the 1940's and have had a further, sharp growth since mid-1950, when the current defense program was initiated. Consequently, demand for personnel in the chemical professions has mounted and shortages have developed in many areas of employment, despite the greatly increased supply of qualified chemists and chemical engineers.

Because of these manpower shortages and the importance of the chemical professions to the defense program, information on current and prospective personnel resources in these professions now has special significance. This report is based on a 1951 survey which included approximately 52,000 chemists, 13,000 chemical engineers, and 7,000 graduate students of chemistry and chemical engineering. 1/ It contains information on the fields of specialization, age, military status, and educational background of both the experienced scientists and engineers and the graduate students. The relative numbers of chemists and chemical engineers employed in different industries, the functions they performed, and the incomes they received are among the other topics discussed. Wherever possible, separate information is given for women scientists--thus providing the first comprehensive data on the employment of women in a major scientific field. In addition, recent trends in the employment of chemists and chemical engineers are traced by comparing the findings of the survey with those of earlier studies carried out by the Bureau of Labor Statistics.

1/ This 1951 survey was conducted by the National Scientific Register, with the cooperation of the American Chemical Society. The Register staff had primary responsibility for the development of the questionnaire and of technical and administrative procedures, and served as the coordinating agency for the various cooperating groups. The questionnaires were edited and coded in the Boston regional office of the Bureau of Labor Statistics, under contract with the Register, which also supplied the basic machine tabulations for the present report. The study was planned and the report written in the Bureau of Labor Statistics.

SUMMARY OF FINDINGS

Chemists

Chemists Included in the Survey

The approximately 52,000 chemists covered by this survey comprised more than half the profession in mid-1951. The 3,900 women chemists included likewise represented more than half of all women in the profession. In addition, the survey covered approximately 6,000 graduate students of chemistry, two-thirds of all graduate students majoring in this subject in 1951. About two-thirds of the respondents were members of the American Chemical Society.

Fields of Specialization

Most industrial applications of chemistry are in the field of organic chemistry, and almost half the chemists surveyed cited this as their field of highest competence. Much smaller numbers classified themselves as specialists in other branches of chemistry, as follows: analytical chemistry, 13 percent; inorganic chemistry, 9 percent; physical chemistry, 8 percent; agricultural and food chemistry, 6 percent; biochemistry, 6 percent; and pharmaceutical chemistry, 4 percent. Three percent were scattered among other specialties, and the remaining 5 percent were classified as general chemists.

Among graduate students, many of whom had not yet progressed far enough in their studies to specialize, the proportion classified in general chemistry was much higher (26 percent). Those who indicated a specialty most often reported organic chemistry, with physical chemistry in second place.

Organic chemistry was also the leading specialty among women chemists, but much higher proportions of women than of men were analytical chemists and biochemists.

Age

Chemistry continues to be a growing profession. Two out of three chemists in this 1951 survey were under 40 years of age. Their median age was 35, only 2 years higher than that of all chemists in 1940.

Women chemists are concentrated in the younger age groups. Their median age was found to be 29 years. Among the chemists of all ages, only 1 out of 13 was a woman, but among those under 30 the proportion of women was much higher, 1 out of 6.

Military Status

Of the 46,000 men chemists who reported their military status, 914 were on active duty with the Armed Forces in mid-1951 and 7,050 were members of reserve organizations. Thirty-six of the women chemists were also reservists. This means that close to 15 percent of all chemists might be affected by a call-up of all reservists.

A much higher proportion of the younger chemists was reservists--19 percent of the men under 26, and 24 percent of those aged 26-34 years. In addition, 20 percent of the graduate students were in reserve organizations.

Educational Background

Although emphasis on graduate training has increased in this as in many other professions during recent decades, the majority of chemists have only bachelor's degrees. This was the highest degree held by 54 percent of the surveyed scientists. Five percent had entered the profession without completing college. Seventeen percent had obtained but not gone beyond the master's degree, and 24 percent held the Ph.D. The proportion of Ph.D.'s was higher among chemists in the survey than among all chemists in the country; it is estimated that not more than 15 percent of the Nation's chemists held Ph.D.'s at the end of 1950.

In two specialties, biochemistry and physical chemistry, approximately half the respondents held doctorates. In all other fields, scientists with graduate degrees were in the minority.

Relatively few women chemists in the survey had Ph.D.'s--only 14 percent compared with 24 percent of the men. The characteristic graduate degree for women chemists was the M. S., whereas for men it was the Ph.D.

Few scientists enter this profession from other fields of study. More than 90 percent of the surveyed chemists and 96 percent of the graduate students obtained their highest degrees in chemistry or chemical engineering. Engineering (exclusive of chemical engineering) was the only other discipline in which a sizable group of chemists (3 percent) took their most advanced training.

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Fields of Employment

The overwhelming majority (95 percent) of the surveyed chemists were working in chemistry in mid-1951. The following information on employment and income is based only on these scientists and excludes the small group (5 percent) who were working in chemical engineering or other scientific or non-scientific fields.

Manufacturing industries were the most important source of employment for these chemists, utilizing twice as many as all other types of employment combined. The 67 percent employed in manufacturing industries compares with 14 percent who were in educational institutions and 8 percent in Federal, State, and local governments. The remaining 11 percent worked for consulting laboratories, nonprofit research institutes, hospitals, mining companies, and various other employers.

The chemicals industries, chiefly industrial organic and inorganic chemicals, employed the majority (53 percent) of the chemists in manufacturing. Ten years before, in 1941, the corresponding figure was less than 45 percent, according to a BLS survey. This comparison reflects the tremendous expansion of the chemical industries over the past few years. The petroleum, rubber, food, and paper industries were also major employers of the surveyed chemists.

Manufacturing industries are particularly important as a field of employment for chemists without graduate training. Three-fourths of the surveyed scientists holding only bachelor's degrees were employed in this field, compared with three-fifths of the masters and half of the Ph.D.'s. There were only two specialties, organic and pharmaceutical chemistry, in which the great majority of the Ph.D.'s were in manufacturing industries.

Among the women chemists, the proportion employed in manufacturing industries was 49 percent, much lower than among the men (72 percent). The only manufacturing industries which employed sizable numbers of women chemists were organic and inorganic chemicals, drugs and medicines, and food and kindred products. On the other hand, more than twice as large a proportion of the women (28 percent) as of the men (13 percent) were employed in educational institutions.

Functions Performed

The principal activity of chemists is research. Close to half of those in the survey (45 percent) were employed chiefly

in research and development in 1951. Much smaller numbers were engaged in analysis and testing (18 percent), management (11 percent), teaching (11 percent), production (6 percent), technical sales (4 percent), and a variety of other functions. Even among the chemists in colleges and universities, 21 percent indicated that research and development work was their chief function. The proportion of chemists employed in this type of work was, however, much higher in government (51 percent) and in the manufacturing industries (49 percent).

The relative numbers of chemists performing various functions were directly related to the scientists' educational background. Among the Ph.D.'s, 55 percent were engaged in research and development and 26 percent in teaching. The corresponding figures for chemists with only master's degrees were 49 and 18 percent, and for those with only bachelor's degrees, 41 and 3 percent. Second to research, analysis and testing was the primary activity of the chemists without graduate degrees.

In general, the proportion of chemists engaged in research was higher in the younger than the older age groups. On the other hand, management and teaching bulked much larger in the activities of the older than of the younger men.

Although research was the leading activity of the women as well as the men chemists, a smaller proportion of the women (37 percent) than of the men reported this as their chief function. Nearly as many women (31 percent) were employed in analysis and testing as in research. Another large group (19 percent) were teachers.

Professional Income

The median professional income of the surveyed chemists was $5,500 a year in mid-1951. This figure was probably somewhat higher than the median income of all the country's chemists, owing to the disproportionately large number of Ph.D.'s in the survey, but it is estimated that the difference was not more than a few hundred dollars.

The chemists under 25 years of age had a median annual income of $3,400. In the older age groups, median earnings increased to a peak of $7,900 for the chemists between 55 and 60 years of age.

Education was another determinant of income. The Ph.D.'s in the survey had a median income of $6,900, compared with $5,400 for the chemists with only master's degrees and $4,900 for those with bachelor's degrees.

The scientists in private industry tended to have considerably higher earnings than those working for other types of employers. Their median income was $5,800, compared with $5,000 for the government employees and $4,900 for the educators.

In general, the women in the survey had considerably lower average incomes than the men of comparable age and educational background, largely because of their more limited opportunities for employment and advancement. The gap in earnings was especially wide in the older age groups. For example, among the 50-54 year-old chemists with only bachelor's degrees, median income was $4,500 for women and $8,300 for men. Among those ages 30-34, on the other hand, the median was $4,100 for women and $5,200 for men.

Chemical Engineers

Chemical Engineers Included in the Survey

Nearly a third of all the country's chemical engineers were included in the survey. The majority of these 13,000 engineers were members of a professional society. The survey also covered approximately 1,000 graduate students of chemical engineering, slightly over a third of all those enrolled during the academic year 1950-51.

Age

The rapid growth of the chemical engineering profession is reflected in the age distribution of the chemical engineers in the survey. Their median age was 32 years, compared with 35 for the surveyed chemists. Only 20 percent of the engineers had reached the age of 40.

Military Status

A sizable proportion of the Nation's chemical engineers would be affected by a general call-up of reservists. One out of every four engineers in this 1951 survey was a member of a reserve organization. This was a somewhat higher proportion than was found among chemists (one out of seven). In the 26-34 year age group, one out of every three chemical engineers was a reservist.

About the same proportion of graduate students (26 percent) as of experienced chemical engineers were in reserve organizations.

Educational Background

Chemical engineers hold doctor's degrees more often than do engineers in other specialties, but not as frequently as chemists. Only 7 percent of the surveyed chemical engineers, compared with 24 percent of the chemists, had obtained doctorates. In both professions, the proportion of Ph.D.'s was higher among the groups surveyed than among all the country's chemists and chemical engineers. Nevertheless, nearly three times as many of the reporting chemical engineers held master's or second professional degrees (20 percent) as held doctorates, and for 71 percent the baccalaureate was the highest degree held. Only 2 percent had no college degree.

Even fewer chemical engineers than chemists enter their respective professions from other fields of study: 97 percent of the surveyed chemical engineers had obtained their highest degrees in either chemical engineering or chemistry, compared with 90 percent of the chemists.

Fields of Employment

Usually it is easier for a chemical engineer to work as a chemist than for a chemist to enter the chemical engineering field. Seven percent of the respondents who classified themselves as chemical engineers were employed in chemistry at the time of the survey. In contrast, only about 1 percent of those who reported their field of highest competence as chemistry were employed in chemical engineering.

Besides the group working in chemistry, a few of the chemical engineers (1 percent) were employed in other engineering and scientific fields, and 2 percent were in nonscientific fields. However, the great majority (90 percent) held jobs in chemical engineering in mid-1951. The following information on employment and income is based on these engineers only and does not cover the small group with jobs in chemistry or other fields.

Manufacturing industries employed most of these chemical engineers (84 percent), an even higher proportion than of the chemists in the survey (67 percent). Few reporting engineers worked for government agencies or for educational institutions (4 percent in each case). Another 5 percent were working for research and consulting laboratories or firms performing engineering services. The remaining 3 percent reported employment in public utilities, mining, construction, and various other fields.

Less than half the chemical engineers employed in some branch of manufacturing were in the chemicals industries. This was a somewhat smaller proportion than for the chemists. On the other hand, the petroleum and machinery industries employed a higher percentage of chemical engineers than of the chemists.

Jobs outside of manufacturing were a significant source of employment only for the small group of chemical engineers who held Ph.D.'s. Thirty percent of the Ph.D.'s—as opposed to 4 percent of all chemical engineers—were employed in educational institutions.

Functions Performed

Although chemists and chemical engineers employed in manufacturing industries may work side-by-side, they frequently perform different functions. The activities in which the surveyed chemists were most often engaged were, first, research and development and, second, analysis and testing. Among the chemical engineers, almost as large a proportion were in production work (28 percent) as in research and development (31 percent) and a relatively large group were engaged in design (12 percent). About the same proportion of chemical engineers as of chemists had attained managerial positions (10 percent). The remaining chemical engineers were engaged in analysis and testing (7 percent), technical sales and services (3 percent), consulting work (4 percent), and various other functions.

The men with graduate degrees were more likely to be engaged in research and development than were those with only bachelor's degrees. In addition, the proportion of teachers was highest among men with the most advanced training. Relatively few chemical engineers with graduate degrees were doing analysis and testing or production work.

Income

The median annual professional income of all chemical engineers in the survey was $5,600. Three out of four reported an income of at least $4,400, and one out of four earned more than $7,300 a year.

A comparison of the incomes of these chemical engineers with those of the surveyed chemists shows, as do previous studies, that chemical engineers tend to earn more than chemists of comparable age. The difference in income levels was widest in the older age groups. Among the respondents aged 55-59,

for example, the engineers had a median income of $11,400, $3,500 higher than the median for chemists, but in the 25-29 year age bracket the difference in median income between the two professions was only $500.

At every age level, the relatively small number of chemical engineers with graduate degrees had higher average incomes than those with less academic training. The median income figure for Ph.D.'s of all ages was $7,900, compared with $5,900 for the masters and $5,400 for the bachelors.

Chemical engineers employed in private industry tended to have higher incomes than those of comparable age in other types of employment. The government workers had the lowest median income in every age bracket, but the income difference was small among the younger men. Thus, chemical engineers aged 25 to 29 had a median annual income of $4,000 in government agencies, $4,300 in educational institutions, and $4,600 in private industry. In the 40-44 year age group, on the other hand, the median annual income of the government employees was $6,100, compared with $8,100 for the educators, and $8,200 for the engineers in private industry.

The relatively high incomes reported by the engineers in educational institutions were due in part to the fact that close to 60 percent of them held Ph.D. degrees, whereas only 5 percent of those in government and private industry had doctorates. It must also be borne in mind, in interpreting the findings on income, that many faculty members of engineering schools have opportunities to supplement their salaries by consulting and other outside work.

THE SURVEYED CHEMISTS AND CHEMICAL ENGINEERS

The mailing list used in this survey had two major sources—the membership roster of the American Chemical Society and supplementary lists of qualified chemists and chemical engineers compiled by local sections of the Society. Altogether, approximately 130,000 questionnaires were mailed, about half to ACS members and the rest to persons not affiliated with that Society.

As of August 31, 1951, which was the cut-off date for inclusion in this statistical study, a total of 83,801 returns had been received, of which 74,300 were usable. The nonusable returns included some which were improperly or incompletely filled out and also returns from scientists or other persons who reported a field of highest competence other than chemistry or chemical engineering. Such returns were omitted from the present study, as were the approximately 2,000 questionnaires sent in by undergraduate students. The total number of questionnaires included in the statistical tabulations was thus only about 72,000.

In order to determine the proportion of Society members among the respondents, a random sample of the usable returns was selected. Sixty-four percent of the persons in this sample group were found to be ACS members, and another 6 percent (who did not belong to ACS) were members of the American Institute of Chemical Engineers. Undoubtedly, many of the engineers who were ACS members were affiliated also with the Institute, although no statistics are available on this point. It is estimated that, in 1951, roughly half the country's chemists and chemical engineers belonged to one or both of these societies. Thus, the proportion of society members was higher among the scientists and engineers in this survey than in the two professions as a whole. This may be one reason why the survey included a larger proportion of the Ph.D.'s in these professions than of the chemists and engineers with less formal education. 2/

Of the 72,189 respondents included in this study, 51,963 were classified as chemists (on the basis of their own statement as to their field of highest competence), 13,369 were classed as chemical engineers, and the remainder were graduate students of chemistry (5,880) or chemical engineering (977). The employment status of the experienced scientists and engineers was as follows:

2/ For further details on this point, see pp. 16 and 41-42.

	Chemists	Chemical engineers
Total.....	51,693	13,369
Employed.....	51,155	13,314
Unemployed.....	122	28
Retired.....	686	27

Information on the specialties of the retired chemists and chemical engineers who sent in questionnaires is given in tables A-1 and A-29, but this small group has been excluded from all other tables and from all of the analysis. The few respondents who were unemployed at the time of the survey are included with the vastly larger numbers who were employed except where an indication is made to the contrary. Separate figures are given for graduate students in all cases.

Coverage of Chemists

There were approximately 100,000 professionally active chemists in the country in 1951, according to a BLS estimate. The 51,277 chemists in the current study thus comprised more than half of all those in the profession. The 3,900 women chemists (7 percent of the total number in the survey) likewise represented over half the women in the field. Comparisons of the findings of this survey with those of earlier studies suggest that the chemists included here were generally representative of the profession with respect to age, field of specialization, and type of employer (i.e., private industry, government, education), although their level of education differed to some extent from that of the entire profession.

The total number of professionally active chemists with doctorates was about 15,000 in 1951. 3/ The present survey included approximately 12,000 Ph.D. chemists, or about 80 percent of the national total. No exact estimate of the total number of active chemists with only master's or bachelor's degrees can be made for 1951. It is estimated, however, that roughly half of all such chemists were included in the study. Although the proportion of bachelors and masters in chemistry and chemical engineering in the survey was thus considerably lower than that of

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3/ This estimate is based on the statistics on doctorates granted in chemistry and biochemistry compiled by the National Research Council for each year since 1912, adjusted for losses by death and retirement.

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Ph.D.'s, the coverage of these groups is considered large enough to permit broad conclusions as to their characteristics and employment.

The total number of graduate students of chemistry and biochemistry enrolled during the academic year 1950-51 has been estimated at approximately 8,000 by the National Research Council. This survey, which included 5,880 graduate students (of whom 425 were women), thus covered about two-thirds of all such students.

Coverage of Chemical Engineers

A smaller proportion of the Nation's chemical engineers than of all chemists were included in the present survey. Of the total of more than 45,000 professionally active chemical engineers in 1951, the survey included 13,342, or between a fourth and a third. The approximately 1,000 graduate students of chemical engineering in the study represented slightly over a third of those enrolled during the academic year 1950-51.

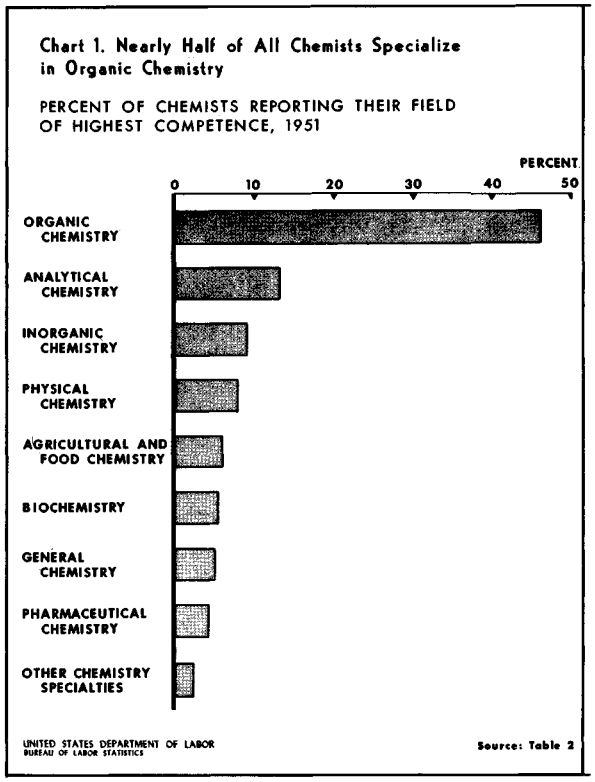
Comparisons with earlier studies suggest that, like the chemists, the surveyed chemical engineers were generally representative of the profession with respect to such key characteristics as age and type of employment. As in the case of chemists, there was a higher proportion of Ph.D.'s among the surveyed chemical engineers than in the profession as a whole in 1951—7 percent, compared with approximately 3 percent. However, the actual number of engineers with Ph.D.'s was so small that this disproportion could not have significantly affected the over-all findings.

PART 1 – CHEMISTS
Labor Supply in Chemistry

Fields of Specialization

Of all the natural sciences, chemistry has made the largest direct contribution to industrial growth. The giant chemical industries built up in this country since World War I were made possible by the discoveries of chemists, who benefited in turn from the resulting employment opportunities. The profession is so closely associated with industry that the relative numbers of chemists in different specialties reflect, to a considerable extent, the degree of emphasis on each specialty in industrial research and development programs.

Most industrial applications of the science are in organic chemistry. Consequently, many more chemists specialize in this than in any other branch of the profession. In filling out the questionnaire in this survey, each respondent was asked to select from a list of detailed specialties the one he considered his field of highest competence. Nearly half (46 percent) of the chemists cited specialties in organic chemistry. The next largest groups were in analytical chemistry (13 percent), inorganic chemistry (9 percent) and physical chemistry (8 percent). The proportions with highest competence in other fields were: in agriculture and food chemistry, 6 percent; in biochemistry, 6 percent; in pharmaceutical chemistry, 4 percent; and in all other specialties combined, 3 percent. The remaining 5 percent were classified as general chemists (table A-1 and chart 1). 4/ Information on the detailed specialties reported by the chemists will be found in table A-2.



4/ Table A-1 contains separate information on fields of highest competence for the employed, unemployed, and retired chemists, and for graduate students of chemistry. The retired chemists are omitted from all subsequent tables. Information pertaining to graduate students is shown separately wherever it is presented.

Women chemists.--Although the figures presented above include both men and women, they reflect primarily the specialties of the men, who comprised 93 percent of all the surveyed chemists. The women were distributed very differently among the various branches of the profession. Nearly as many women were specialists in analytical chemistry (23 percent) as in organic chemistry (25 percent). The proportion specializing in biochemistry was also comparatively large (table A-3), and so was the group classed as general chemists, among whom were many women high school teachers and the group who taught introductory chemistry courses in college.

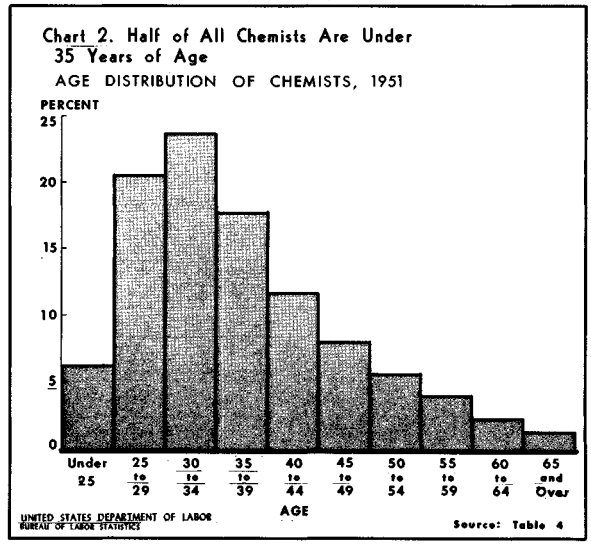
Graduate students.--The graduate students in the survey likewise included a sizable group (26 percent) classified as in general chemistry, but for a different reason: many had not yet gone far enough in their studies to become specialists. Like experienced chemists, the students who had specialized were most often in organic chemistry. In general, the distribution of graduate students among the various fields of specialization was similar to that of experienced chemists holding graduate degrees, except with respect to the expanding field of physical chemistry: a much higher proportion of graduate students than of M.S. and Ph.D. chemists were specialists in this branch of chemistry. The numbers of graduate students in the various fields of specialization are shown in table A-1.

Age

The continued growth of the chemical profession is reflected in the low average age of its members. Two-thirds of the chemists in this survey were under 40 in mid-1951 (chart 2). Their median age was 35, only 2 years higher than the median age of chemists in 1943 5/ and at the time of the 1940 Census.

Among the chemists in various specialties, the oldest groups were the food and agricultural chemists, with a median age of 38.

Chart 2. Half of All Chemists Are Under 35 Years of Age



5/ Factors Affecting Earnings in Chemistry and Chemical Engineering, (p. 3), Bulletin No. 881, 1946. U. S. Department of Labor, Bureau of Labor Statistics.

The two youngest groups, each with a median age of 33, were the analytical and the general chemists (table A-4).

Women chemists.--The women in this profession are concentrated in the younger age groups to a far greater extent than the men. The median age of the surveyed women was 29, and close to 80 percent were under 40 (table A-5). Among chemists of all ages, only 1 out of every 13 was a woman, but in the age groups under 30 a sixth of the surveyed chemists were women. Apparently, many women chemists stop working when they marry and have families.

Graduate students.--The largest group (48 percent) of the chemistry students surveyed were between 25 and 30 years of age at the time of the survey. Fifteen percent were 30 or over. Only 37 percent were under 25, as shown in table A-5. The main reason why the proportion of students under 25 was not higher was undoubtedly the large contingent of veterans in the student group.

Citizenship Status

The great majority of chemists in this survey (93 percent) were native-born Americans. Most of the others were naturalized (5 percent) or aliens in process of naturalization (1 percent). Only 275 chemists (0.5 percent) were resident aliens who had not applied for citizenship. The only fields with relatively high proportions of foreign-born chemists were pharmaceutical chemistry and biochemistry. In both these specialties, naturalized citizens and aliens constituted about 11 percent of all respondents (table A-6).

Military Status

The military status of the members of a profession must be taken into account in evaluating personnel resources in that field, especially with reference to the impact of further mobilization. There were 7,050 members of reserve organizations among the 46,000 men chemists who reported their military status, and 36 of the women chemists were in reserve organizations. This means that close to 15 percent of all chemists might be affected by a call-up of all reservists.

A much higher proportion of the younger men were reservists--19 percent of those under 26 and 24 percent of those between 26 and 35. For chemists aged 35 or over, the corresponding figure was only 8 percent. About the same proportion of graduate students (20 percent) as of young chemists were in the Reserves.

Men on active duty with the Armed Forces as of mid-1951 represented a sizable group (13 percent) among the surveyed chemists under 26 years of age. Of those over 25, only 2 percent were on active duty. It appears, therefore, that most of the chemists in the Armed Forces were draftees rather than reservists. Altogether, 914 chemists representing 2 percent of the men in the survey, were in the Armed Forces in 1951. Slightly less than a third (298) reported that they were doing scientific work. It should be noted, however, that the survey findings probably understate the proportion of all chemists who were serving in the Armed Forces in 1951, because difficulties were experienced in contacting such persons by mail questionnaire. Furthermore, the rate of nonresponse was undoubtedly high among men in this group.

Detailed figures on the military status of reporting chemists and graduate students in each age group are shown in tables A-7 and A-8.

Level of Education

In chemistry, as in many other professions, graduate training has received increasing emphasis during the past three decades. Nevertheless, the baccalaureate is still the highest degree held by the majority of chemists. Fifty-four percent of those surveyed had only a bachelor's degree. Five percent had entered the profession without completing college, though practically all of them had done some college work. Seventeen percent held master's degrees but no doctorate, and 24 percent had Ph.D.'s. 6/ This last figure was influenced by the survey's higher coverage of Ph.D.'s than of scientists with less academic training; it is estimated that not more than 15 percent of the Nation's chemists held Ph.D.'s at the end of 1950.

In two fields of specialization, biochemistry and physical chemistry, the proportion of Ph.D.'s is far above the average for the profession. In both these fields, approximately half the surveyed chemists held Ph.D.'s. In all other fields, the bachelor's degree was the most common (table A-9).

6/ For convenience, the designation "Ph.D." is used here and throughout the report to refer to all scientists with earned doctorates in philosophy, science, or education. Similarly, the designations "B.S." and "M.S." cover persons with degrees in arts as well as those with degrees in science.

Differences in average age between the scientists holding bachelor's degrees only and those with more advanced training can be accounted for partly by the time required to obtain graduate degrees. The median age of the bachelor's was 33 years, compared with 36 years for the master's and 39 for the Ph.D.'s. The relatively small number of chemists who had never completed college also had a median age of 39. Despite general recognition of the importance of college training for scientific work, it has continued to be possible in recent years for a few people without college degrees to enter the profession (table A-10).

Women chemists.--For women chemists, the characteristic graduate degree was the master's degree--held by 21 percent of those surveyed--whereas for men it was the Ph.D. Only 14 percent of the women chemists, compared with 24 percent of the men, had Ph.D.'s. The great majority of women (63 percent) held the B.S. as their highest degree, and only 2 percent had no college degree.

There were sharp differences in educational background between the younger and older women chemists (table A-10). Thirty-nine percent of the women aged 40 or over held Ph.D.'s and 70 percent had at least a master's degree; on the other hand, only 25 percent of those under 40 had obtained an advanced degree. In fact, unlike men chemists holding doctor's degrees, most of the women Ph.D.'s were over 40, as shown by the following figures:

	Chemists with Ph.D.			
	Men		Women	
	Number	Percent	Number	Percent
Under 40 years	6,258	54.6	212	39.6
Over 40 years	5,209	45.4	324	60.4

The preponderance of masters and doctors among the older women chemists suggests that women with advanced degrees are less likely to drop out of the profession at an early age than those who have made less of an educational investment. It is also possible that women who entered the profession more than 15 years ago felt that an advanced degree was essential. At that time the only substantial employment opportunities for women were in educational institutions, where there is more emphasis on formal training than in other types of employment.

Graduate students.--About 70 percent of the graduate students in this study held only bachelor's degrees. Twenty-eight percent of those surveyed had master's degrees and were presumably working toward a doctorate, and 2 percent were engaged in post-doctoral work. Among women graduate students the proportion doing advanced work was lower, as shown in table 1.

Table 1.--Highest degree held by men and women graduate chemistry students, 1951

	Men		Women	
	Number	Percent	Number	Percent
Total	5,455	100.0	425	100.0
Ph.D. degree	124	2.3	7	1.7
Other doctor's degrees...	5	.1	1	.2
Master's degree	1,542	28.3	94	22.1
Bachelor's degree	3,784	69.3	323	76.0

Major Subject for Highest Degree

As would be expected of a group of scientists whose fields of highest competence were in chemistry, the great majority (77 percent) of the surveyed chemists obtained their highest degrees in that science. Moreover, most of the others--the 13 percent who had majored in chemical engineering--had also received much formal training in chemistry. The two fields of study are therefore combined in the following analysis.

There were some differences among the scientists at the various levels of education in the proportion that had taken their highest degree in chemistry or chemical engineering. Only 5 percent of the Ph.D.'s had obtained doctorates in other subjects--usually in one of the agricultural or biological sciences (table A-11). Among the chemists with bachelor's degrees only, the proportion who had majored in other subjects was 10 percent; most of this small group took their degrees in other branches of engineering. The chemists whose highest degree was the master's included a few (5 percent) who had taken this degree in education, presumably to prepare themselves for high school teaching. This was one reason why a higher proportion of the masters (14 percent) than of either the bachelors or doctors had done their most advanced academic work outside chemistry or chemical engineering.

These findings can be compared with figures for physicists from the National Scientific Register survey of that profession. 7/ Twenty percent of the physicists at all levels of education had earned their highest degrees in a field other than physics, and 14 percent in fields other than physics or electrical engineering, from which many electronics physicists have been drawn in recent years. The greater proportion of recruits from other fields among the physicists than the chemists may be explained, at least in part, by the greater shortage of personnel in physics than in chemistry in recent years.

The graduate students surveyed were primarily young people who had previously selected chemistry or chemical engineering as their chief field of interest. Only 4 percent of the total of about 4,000 students who were still working toward their first graduate degree had majored as undergraduates in subjects other than chemistry or chemical engineering. Among the approximately 1,600 students who held the master's degree, all but 5 percent had taken this degree in either chemistry or chemical engineering, and all but 2 percent of the small group of post-doctoral students had obtained their Ph.D.'s in one of these two fields. In general, the study indicates that the chemistry profession can count on few recruits from other fields of undergraduate study.

7/ Manpower Resources in Physics, 1951 (Scientific Manpower Series No. 3 of the National Scientific Register). U. S. Department of Labor, Bureau of Labor Statistics and Federal Security Agency, U. S. Office of Education, National Scientific Register, 1952.

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Employment

Fields of Employment

Every profession sooner or later loses some of its trained members to other fields of employment, and chemistry is no exception. Even among the respondents in the current survey who considered chemistry their field of highest competence, there were some who were employed in fields other than chemistry at the time they filled out the questionnaire. However, these scientists were only a small group--2,570 (5 percent) of the surveyed chemists. Furthermore, 723 of them were employed in chemical engineering and 461 in other fields of science or engineering. Only 1,386 (3 percent of all the chemists) were employed in nonscientific, nonengineering jobs.

The great majority of the chemists in the survey (85 percent) reported that they were currently employed in the branch of chemistry in which they were most competent. The proportion so employed was highest among the organic chemists (87 percent) and lowest (69 percent) among the specialists in inorganic chemistry. 8/

Most of the chemists not employed in their first specialty were working either in another branch of chemistry or in general chemistry. The general chemists were usually educators, who taught either courses in general chemistry or courses in several branches of the science. However, many such educators carry on research in one branch of chemistry, which they regard as their field of highest competence.

Table A-12 shows the number of chemists employed in each branch of the profession at the time of the survey, cross-classified

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8/ In interpreting these findings it must be borne in mind that questionnaire respondents tend to report the field in which they are currently working as their field of highest competence, especially if two or more specialties might be applicable. Nevertheless, the proportion of chemists employed in their field of highest competence is noteworthy. The National Scientific Register survey of physicists showed that the proportion of physicists employed in their field of highest competence was lower than that found among chemists--probably because of the sizable proportion of physicists who had teaching positions and were classed as in "Physics, general."

by their fields of highest competence. As this table indicates, each field had both gained and lost some scientists. The net effect in most fields was a current employment figure which came close to the number of scientists who considered themselves specialists in that field. However, in a few fields, notably inorganic chemistry, the number currently employed was significantly lower than the number with first competence in that area of chemistry. The personnel loss from inorganic chemistry suggests that personnel resources are somewhat greater than requirements in this field, possibly because of the traditional emphasis on inorganic chemistry in studies leading to the master's degree.

Relatively high proportions of analytical and physical chemists were also employed outside their respective specialties, the largest group in each case being employed in organic chemistry. In all probability, however, most of the analytical and physical chemists employed in other branches of chemistry were doing work closely related to their field of highest competence.

The remainder of Part I--which discusses the industries where chemists are employed, the functions they perform, and the income they receive--is based on the approximately 47,000 respondents who were working in chemistry at the time of the survey. The 2,570 who were employed in other scientific or nonscientific work are excluded from this analysis.

Industries Where Employed

Unlike most other scientists, chemists are employed primarily in private industry. The members of the chemistry profession who were working in that science at the time of the survey were employed in manufacturing industries in two out of every three cases. One out of 10 had jobs with business concerns of other types--including consulting firms, mining and construction companies, and public utilities. Altogether, about three-fourths of the employed chemists were in private industry. In contrast, only 14 percent were in educational institutions, and a still smaller group (8 percent) were in Federal, State, and local government agencies (tables A-13, A-14).

There has been a pronounced increase over the last decade in the proportion of chemists employed in manufacturing industries and a marked drop in the proportion in educational institutions. The growth of the profession has been so rapid, however, that even in education the actual number of chemists employed was at least as high in 1951 as 10 years before. Government agencies sharply increased their employment of chemists during the decade, although the proportion of these scientists holding government jobs was somewhat lower in 1951 than in 1941, as shown by table 2.

Table 2.--Type of employment of chemists, 1941, 1943, and 1951

Year 1/	Percent employed in -			
	Manufacturing industries	Government (Federal, State, and local)	Education	Other types of employment 2/
1941	58.7	9.8	22.0	9.5
1943	64.0	11.6	16.1	8.3
1951	66.6	8.3	14.1	11.0

1/ Figures for 1941 and 1943 are based on Factors Affecting Earnings in Chemistry and Chemical Engineering, (p. 17), Bulletin No. 881, 1946. U. S. Department of Labor, Bureau of Labor Statistics.

2/ Includes mining, construction, public utilities, nonprofit foundations, consulting firms, health services, trade and professional associations, etc.

Chemists with only bachelor's degrees are concentrated in manufacturing industries to a greater extent than those with more advanced training. Three-fourths of the bachelors in the survey, compared with three-fifths of the masters and only half of the Ph.D.'s, reported employment in these industries (table A-14).

Educational institutions were a substantial source of employment for scientists holding graduate degrees, particularly those with doctorates. Thirty-two percent of the Ph.D.'s and 16 percent of the masters, but only 3 percent of the bachelors, were working for colleges and universities.

To look at the figures another way, nearly two-thirds of the faculty members in the survey held doctor's degrees (table A-15). It is well known that there is greater emphasis on formal training, especially the doctor's degree, in colleges and universities than in private industry. However, the proportion of Ph.D.'s is probably not as high among all chemistry faculty members in the country as among those in this study, because of the survey's higher coverage of Ph.D.'s than of chemists without doctorates.

There is some evidence also that government agencies attach greater importance to formal education in their employment policies than do most industrial employers of chemists. Two-fifths of the government chemists, compared with one-third of those in

manufacturing industries, held graduate degrees. The chemists who had not completed college were a small group in all types of employment, but they represented only half as large a proportion of the government employees (3 percent) as of the chemists employed in manufacturing industries (6 percent).

Employment in manufacturing industries.--Gains in employment of chemists have been recorded over the past decade in most manufacturing industries. The chemicals industries--the foremost employers of chemists--have expanded their chemistry staffs so greatly that the proportion of all chemists in manufacturing industries who were on their payrolls rose from 44 percent in 1941 to 53 percent in 1951. In the petroleum, rubber, food and kindred products, and paper and allied products industries, the actual numbers of chemists employed also increased significantly, although in most of these industries there was a decrease in the proportion of chemists employed (table 3). In the textile industries, on the other hand, there was an actual reduction in chemistry staffs during the 10-year period, leading to the sharp drop in the proportion of chemists in these industries which is indicated in table 3.

Table 3.--Percent of chemists in manufacturing industries, by type of industry, 1941, 1943, and 1951 1/

Industry	1941	1943	1951
Chemicals and allied products ...	44.3	45.0	53.2
Petroleum and coal products	12.8	12.0	11.3
Rubber products	5.5	5.9	4.3
Food and kindred products	8.9	8.1	7.2
Textile mill products	7.7	3.3	2.3
Paper and allied products	.9	3.6	3.0
All other manufacturing	19.9	22.1	18.7
Total	100.0	100.0	100.0

1/ Figures for 1941 and 1943 are based on Factors Affecting Earnings in Chemistry and Chemical Engineering, Bulletin No. 881, 1946. U. S. Department of Labor, Bureau of Labor Statistics.

Among chemists in manufacturing industries, as in the entire profession, the organic chemists were by far the largest group, and the analytical and inorganic chemists were the next largest groups. Comparatively few physical chemists had jobs in manufacturing industries, and the relative numbers of biochemists and of general chemists employed there were even smaller (table A-16).

The chemicals industries as a group employed especially large numbers of organic chemists; nearly three-fifths of the surveyed chemists in these industries were in the organic field. There were some industries, however, in which organic chemists were not predominant. The drug industry, for example, naturally employed mainly pharmaceutical chemists (table A-16). In the food industries, agricultural and food chemists were in the majority. In the primary metals industry, the number of inorganic and analytical chemists exceeded that of organic chemists. Nearly every industry, however, uses a variety of specialists. Thus, a few of the surveyed scientists in the electrical machinery industry were working in pharmaceutical chemistry; several chemists in the rubber industry had jobs in the field of agricultural and food chemistry, and there were some biochemists in petroleum refining.

Although in private industry as a whole the overwhelming majority of the chemists held only bachelor's degrees, in some branches of manufacturing a sizable proportion had graduate degrees. Industry differences were especially noticeable with respect to the proportion of Ph.D.'s (table A-15). Only 8 percent of the chemists in the primary metals industry and 9 percent of those in the paints and varnishes industry held Ph.D.'s. The proportion with doctorates was larger than this in every other industry for which figures are available. It was highest in the manufacture of professional and scientific instruments (28 percent) and in the drug industry (26 percent).

Employment in government and education.--The majority of the surveyed chemists working for government agencies were Federal employees. Of the 3,898 government chemists, 3,071 were employed by Federal agencies, 519 by State governments, and the remaining 308 by local authorities.9/ Approximately a third of the Federal employees were in the Department of Defense, and the second largest group were in the Department of Agriculture. The Interior Department and the Federal Security Agency--which includes the Public Health Service--also employed sizable numbers. 10/

9/ Among these were 85 members of the Armed Forces on active duty with the Department of Defense.

10/ These findings parallel closely those of a survey conducted in 1951 by the U. S. Civil Service Commission on Federal employment. According to that survey, there were 4,346 persons with the job title of "chemist" as of June 30, 1951. However, there were undoubtedly many more chemists employed by the Federal Government who held jobs as, for example, soil scientist, home economist, and physical science administrator.

The role of Federal, State, and local government agencies in guarding the public health and improving and increasing the food supply is reflected in the specialties of the government chemists. About 40 percent of these chemists were working in analytical chemistry (including those connected with the administration of pure food and drug laws), in agricultural and food chemistry, or in biochemistry (table A-16). In contrast, only a fifth of the chemists in manufacturing industries worked in these fields.

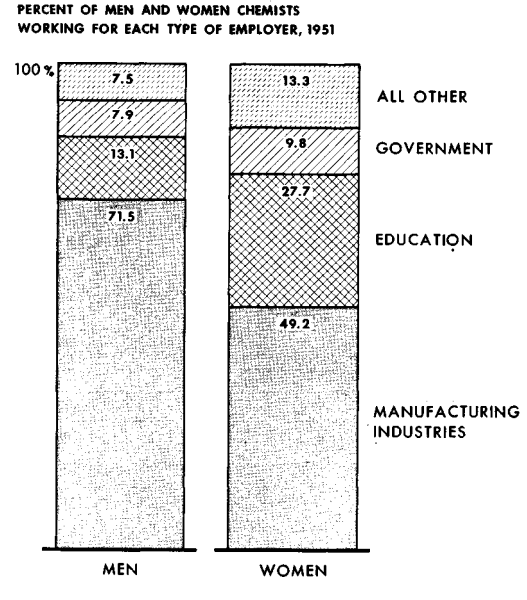
Like government agencies, educational institutions employed a much lower proportion of organic chemists (28 percent) than did manufacturing industries, and higher proportions of specialists in other fields, particularly physical chemistry and biochemistry. Compared with manufacturers, colleges and universities also employed relatively high proportions of chemists whose positions were classified as in general chemistry. Work in general chemistry was, however, more common in secondary schools, which employed 40 percent of all the general chemists in the survey.

Employment of Women

Although far more of the women chemists in this study had jobs in manufacturing industries than in any other area of employment, the proportion employed there was by no means as high as among the men. On the other hand, relatively more women than men reported employment in educational institutions and in hospitals and other types of establishments classed under "All others," as shown in chart 3.

In line with the over-all increase in employment of chemists in manufacturing industries during the past decade, there has been a decided rise in the relative number of women chemists in industrial positions. From the limited evidence available, it appears that employment in manufacturing industries has risen at about the same rate for the women as for the men. Most women thus employed work in a limited number of industries--industrial chemicals, drugs and medicines, food and kindred products, and petroleum. These industries employed almost two-thirds

Chart 3. Nearly Three-Fourths of All Men and Almost Half of All Women Chemists Are in Manufacturing Industries



of the women but less than half of the men who reported that they had positions with manufacturers (table A-17).

The women holding only bachelor's degrees were concentrated in manufacturing industries to about the same extent as the comparable group of men. The employment pattern of women who held advanced degrees, however, differed sharply from that of their male colleagues with the same level of training. Only 19 percent of the women Ph.D.'s and 30 percent of the women with master's degrees worked in manufacturing industries, compared with 51 percent of the men Ph.D.'s and 62 percent of those with M.S.'s.

For women chemists with graduate degrees, educational institutions were the leading source of employment. More than half the women Ph.D.'s and over a third of those holding only master's degrees worked for colleges and universities. It should be noted, however, that only 35 percent of the women in colleges and universities had doctor's degrees compared with 69 percent of the men.

Function

Each chemist was asked to indicate the type of work in which he was primarily engaged at the time of the survey by checking 1 of a list of 10 broad classes of functions. 11/ The principal activity of 45 percent of the respondents was research and development. The proportion was above this average figure in most manufacturing industries, in government, and in research and consulting agencies (table A-18.) In only two major industry groups employing substantial numbers of chemists (the food and kindred products and primary metals industries) were less than 40 percent of the surveyed chemists engaged in research and development. Some of the research in these industries is carried out by specialists in other fields (especially the biological sciences or metallurgy). In colleges and universities, also, a sizable proportion of the chemists (21 percent) were devoting the major part of their time to research and development programs, financed in many cases by business firms or by the Federal Government.

11/ The following function code was used: (1) research, development, or field exploration; (2) consulting, clinical practice, engineering economics, or evaluation; (3) management or administration; (4) teaching; (5) technical writing and editing, patents, or library work; (6) design; (7) inspection, clinical analysis, testing, or analytical and process control; (8) production, operation, maintenance, construction, or installation; (9) technical sales and service or marketing and purchasing; (y) other.

Next to research, analysis and testing was the activity reported by the largest number of chemists, 18 percent of the total. In government agencies--where a number of chemists are needed to assist in such programs as the administration of food, sanitation, and health regulations--almost a third of the chemists were in this kind of work. In the manufacture of primary metals and in food processing, also, relatively high proportions of chemists were doing analysis and testing.

The only other activities reported by sizable numbers of the surveyed chemists were management and teaching, each of which was cited as a chief function by 11 percent of the total. The proportion of chemists in management was above average in those industries which employed the largest numbers of chemists--chemicals and petroleum. Many of the chemists engaged in management in these industries, no doubt were supervising research staffs.

Relatively few chemists, not more than 6 percent in each case, were engaged in production, design, technical sales, consulting, or technical writing. There was a greater tendency to use chemists in production work in the manufacture of drugs and medicines and of paper products than in other industries. The industries in which the proportion of chemists engaged in technical selling was largest were those, such as industrial chemicals, which market their products primarily to other producers (table A-18).

The kind of work a chemist does is more dependent on the amount of formal training he has received than on the industry in which he is employed. In the present survey, almost everyone engaged in teaching had a graduate degree. Research also was carried out more frequently by the chemists with advanced degrees than by those who had not gone beyond the baccalaureate. On the other hand, almost no Ph.D.'s and relatively few holders of the master's degree (11 percent) were in analysis and testing, although approximately a fourth of the bachelors and over a third of the small group who had not completed college reported this as their chief function. Production and technical sales work were other activities which engaged higher proportions of the chemists without graduate degrees than of those with more advanced academic training (table A-19).

Every activity reported here was carried out by some chemists in each age group. However, the chemists doing analysis and testing--which is often routine work--were a younger group than those in other types of activities, whereas the group engaged in management and consulting work were considerably older, on the average, than other members of the profession. The teachers, most of whom were in colleges and universities, also tended to be older than

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most other groups of chemists. Their median age was 40 years, compared with 35 for all chemists in the study (table A-20.) Even among the chemists with graduate degrees, relatively few young men were entering the teaching profession. 12/ Teachers have comparatively low average incomes (as shown by the data in the next section). It is not surprising, therefore, that young scientists should go into research instead of teaching, at a time when there are abundant opportunities for employment in industry and in government.

Women chemists.--Because the great majority of chemists are men, the findings presented so far reflect primarily the activities of the male members of the profession. The pattern was rather different among women chemists. Thus, research and development was the principal activity of only 37 percent of the surveyed women, compared with 46 percent of the men. The next largest group of women chemists (31 percent) were doing analysis and testing--a much larger proportion than for the men (17 percent). Teaching and technical writing were other activities in which relatively more women than men were engaged: 19 percent of the women compared with 11 percent of the men were teachers, and 10 percent of the women compared with 1 percent of the men were technical writers. On the other hand, few women were in managerial positions or production work (1 percent in each case, compared with 12 and 8 percent, respectively, of the men).

Most of the women as of the men teachers held graduate degrees and were in the older age groups. On the other hand, among the women as among the men, most scientists engaged in analysis and testing were young and held only bachelor's degrees. Tables A-21 and A-22 give further data on the functions performed by women chemists, according to level of education and age.

12/ More than 70 percent of the Ph.D.'s under 35 years were in research and development work, but only 36 percent of those over 45. The opposite held true of the relative numbers in each age group engaged in teaching. Less than a fourth of the Ph.D.'s under 35 but 34 percent of those past 45 were teachers. The same relation between age and function is found for holders of the master's degree (table A-19).

Income

The median professional income of all chemists in this survey was $5,500 a year in mid-1951; half earned more and half earned less than that amount. The best paid fourth earned at least $7,400 (the upper quartile) and three out of four earned more than $4,200 (the lower quartile). 13/ These are total annual income figures, including bonuses, fees, royalties, and other professional earnings, as well as salaries. They cover only chemists working as such at the time of the survey, omitting the 5 percent with jobs in other fields. 14/ Because of the survey's disproportionately high coverage of Ph.D.'s and the fact that chemists with doctorates tend to earn more than those with less formal education, the surveyed scientists probably had a slightly higher average income than all chemists in the country. It is estimated, however, that the difference in median incomes was not more than a few hundred dollars. Average earnings in the profession have probably gone up since the time of the survey, owing to the rising demand for chemists during 1951-52 and the general upward trend in earnings throughout the country.

During the past decade there has been a marked increase in chemists' earnings, as in the over-all income level in this country. In 1943, chemists had a median annual income of only $3,280 according to a Bureau survey. 15/

13/ Persons filling out the questionnaire were not asked to state their exact income but were given the following list of brackets to check: Under $3,000, $3,000-$3,999; $4,000-$4,999; $5,000-$5,999; $6,000-$6,999; $7,000-$7,999; $8,000-$9,999; $10,000-$14,999; $15,000 and over. Furthermore, the income question on the questionnaire was marked "optional." However, 80 percent of all the respondents supplied answers to this question. A statistical comparison between those who reported income and those who failed to reply revealed no significant differences between the two groups with respect to sex, age, level of education, or type of employment.

14/ See p. 20.

15/ Factors Affecting Earnings in Chemistry and Chemical Engineering, (p. 11), Bulletin No. 881, 1946. U. S. Department of Labor, Bureau of Labor Statistics. In comparing median incomes in 1943 and 1951, it should be noted that the data from these two surveys are not strictly comparable owing to differences in the age composition and educational background of the surveyed scientists.

Age

The fact that age and experience are important factors in the determination of scientists' income has been demonstrated by several previous surveys. 16/ In the present survey, the highest paid group of chemists were those aged 55-59 years. Median earnings rose from a low of $3,400 for the scientists under 25 to a peak of $7,900 for those between 55 and 60. After the age of 60, a slight decline in earning power was evident (table A-23).

Earnings increased most rapidly in the age groups from 25 to 39. Between these ages, there was a rise of at least $1,000 in median annual income from one 5-year age group to the next. For example, the 30-34 year-old chemists had median earnings of $5,400, whereas the corresponding figure for the 35-39 year-old group was $6,500. Among the scientists past 40, changes in median income between age groups were considerably smaller (table A-23.)

The earnings of individual scientists varied widely both above and below these average figures. This was true in all age groups but especially among the older members of the profession. The chemists under 25 earned more than $2,700 a year in three out of every four cases, and the earnings of the top-paid fourth began at $3,800; the range between these two figures (the interquartile range) was only $1,100. For chemists aged 50-54, the corresponding range was more than five times as great ($6,100); in this age group, the highest paid fourth all earned over $11,800, and the lowest-paid fourth less than $5,700.

Level of Education

The findings of this survey clearly point to the earnings advantage which accrues from academic training--and especially from the doctor's degree--for members of the chemistry profession. At most age levels, chemists with doctorates had higher median and quartile incomes than all other chemists. The median annual income of all Ph.D. chemists in the survey was $6,900 in mid-1951, compared with $5,400 for holders of the master's degree and $4,900 for those whose highest degree was the B.S. (table A-24).

The small group who had not completed their college education had slightly higher over-all median earnings ($5,000) than the holders of bachelor's degrees. This, however, was an apparent rather than a real exception to the general finding that scientists' earnings are

16/ See Employment, Education, and Earnings of American Men of Science, Bulletin No. 1027, 1951, U. S. Department of Labor, Bureau of Labor Statistics; also Manpower Resources in Physics, 1951, National Scientific Register, Scientific Manpower Series No. 3, op.cit.

directly related to their educational level. The chemists without a college degree were an older group than the bachelors, and they were concentrated to an even greater extent in private industry (where earnings tend to be higher than in other types of employment, as indicated in the next section). When age and type of employment are taken into consideration, the scientists with bachelor's degrees are better paid than those without a degree (chart 4).

Table A-24 also shows that, among the surveyed scientists aged 40 and over, the master's degree holders in each age group had lower median earnings than the bachelors; a larger proportion of the former than of the latter worked for educational institutions, where earnings are relatively low. The apparent disadvantage of the scientists holding M.S. degrees, compared with those without a graduate degree, disappears when both age and type of employer are taken into account.

Type of Employer

Earnings of chemists are considerably higher in private industry 17/ than in either educational institutions or government agencies. The median income of the surveyed chemists was $5,800 in private industry, compared with $5,000 in government and $4,900 in colleges and universities. In every age group over 30, the private industry employees with only the bachelor's degree had higher average incomes than the Ph.D.'s in colleges and universities--suggesting that the type of employer for whom a scientist works is likely to have even more effect on his earnings than his degree.

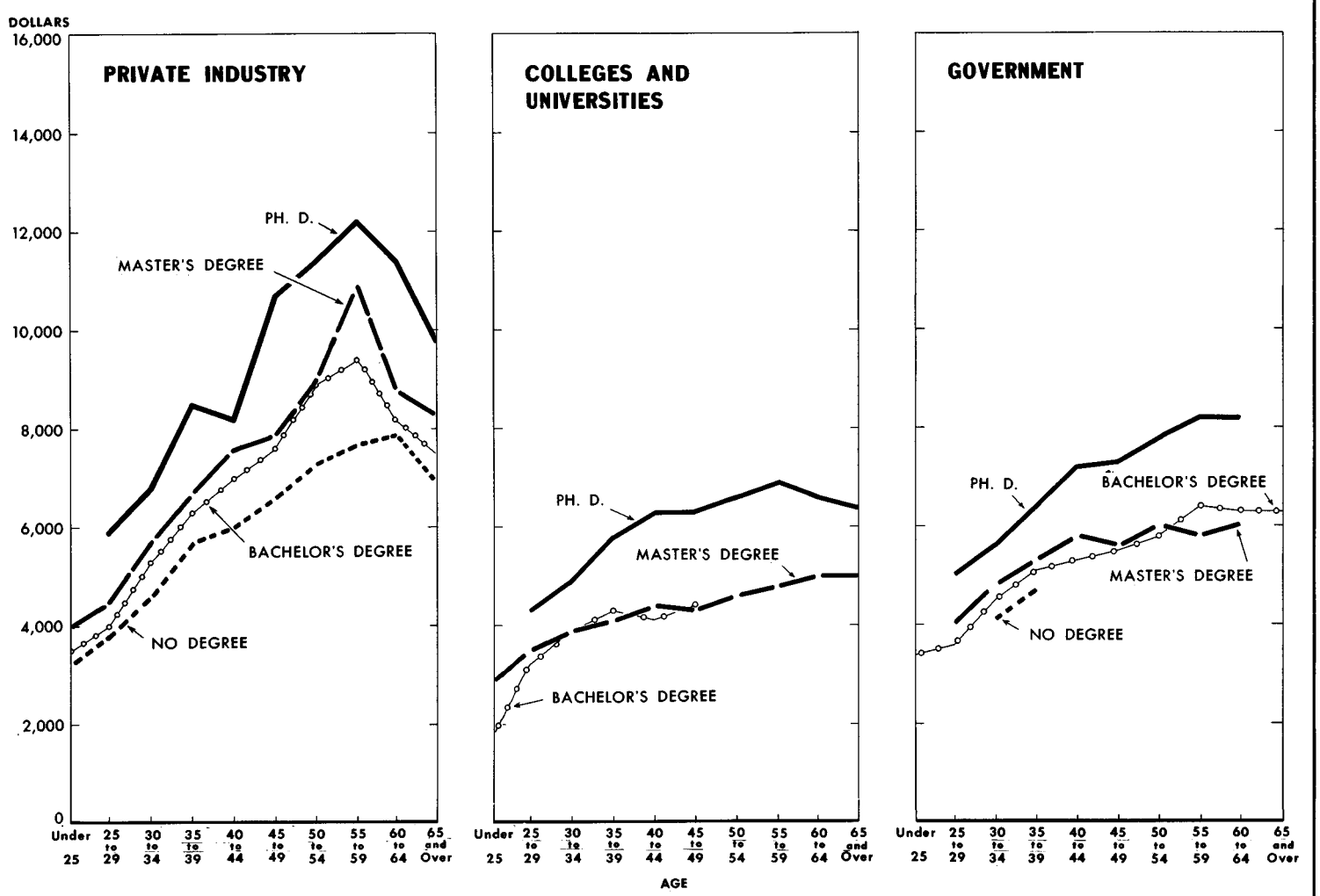
Earnings differences between the scientists in private industry and those working for other employers were especially marked in the case of men near the top of the income scale for their particular type of employment (table A-25).

The income advantage of scientists in private industry also widened markedly with increasing age (chart 5 and table A-25). The 25-29 year-old chemists in private industry had a median annual income of $4,200--only $500 more than the median of $3,700 for those in colleges and universities and also for those in government agencies. In the 35-39 year age group, the income differential between private industry employees and chemists in government and education was much greater, the median income in industry being $6,800 a year compared with $5,400 in educational institutions and $5,500 in government agencies. Among the chemists between 55 and 60--the group with the highest

17/ The chemists classified as working in private industry include employees of business establishments and also independent consultants and other self-employed chemists.

Chart 4. Chemists With Ph. D.'s Are Highest-Paid Group in Each Type of Employment

MEDIAN INCOMES OF CHEMISTS BY AGE, LEVEL OF EDUCATION, AND TYPE OF EMPLOYER, 1951

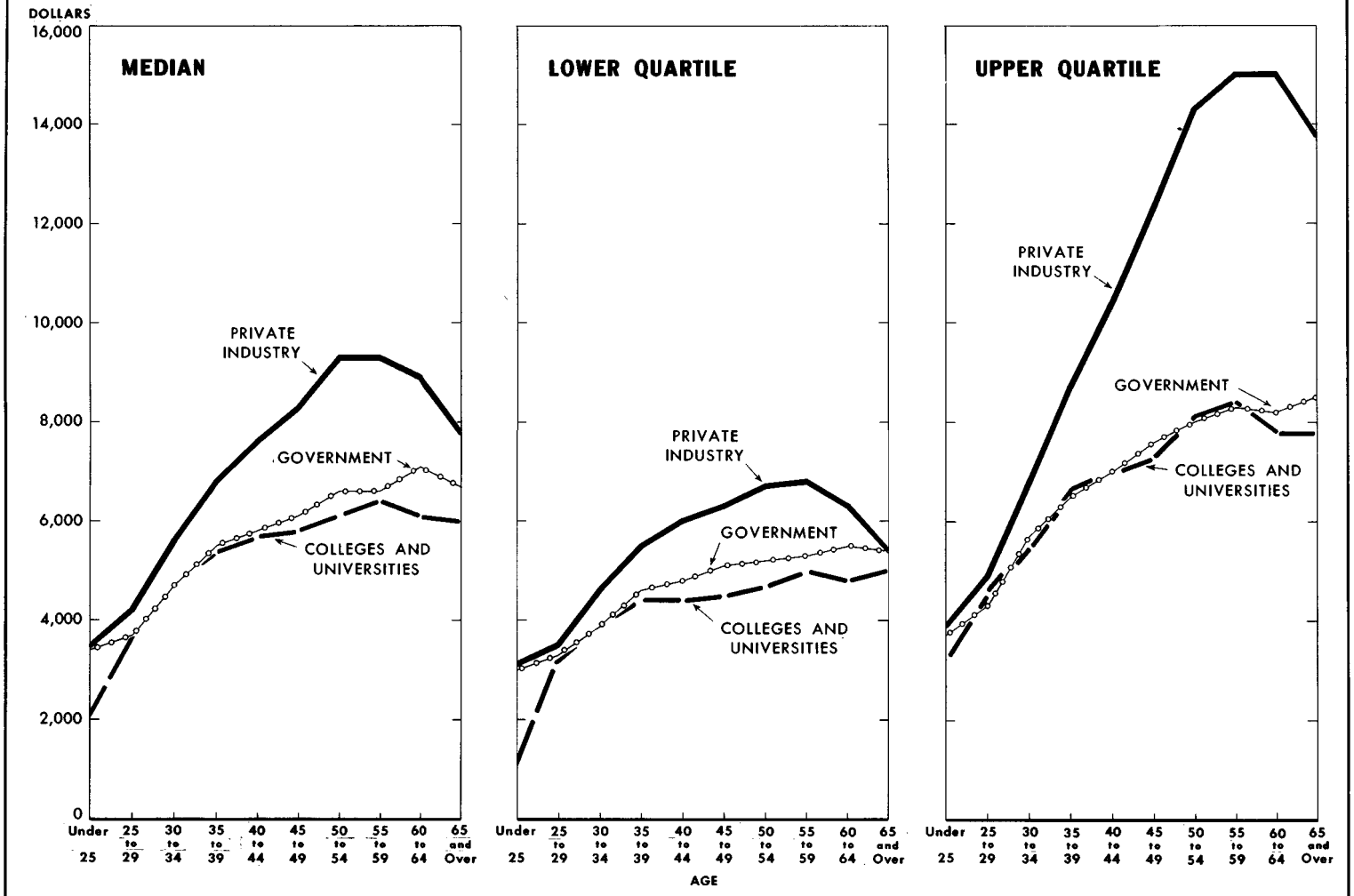


UNITED STATES DEPARTMENT OF LABOR
BUREAU OF LABOR STATISTICS

Source: Table A-26

Chart 5. Incomes of Chemists Are Highest in Private Industry

MEDIAN AND QUARTILE INCOMES OF CHEMISTS, BY AGE AND TYPE OF EMPLOYER, 1951



UNITED STATES DEPARTMENT OF LABOR
BUREAU OF LABOR STATISTICS

Source: Table A-25.

earnings--the median annual income of private industry employees exceeded by almost $3,000 that of faculty members and government employees.

Income differences between the private industry employees and other scientists were also greater for the chemists with doctorates than for those with less academic training (table A-26). It is obvious that, in all cases, the highest-paid groups--the oldest, the best educated, the most successful--derived the most financial advantage from employment in private industry, where ceilings on salaries are much less rigid than in government agencies and educational institutions.

The small group of chemists working for nonprofit research agencies (excluding membership organizations such as trade associations) tended to have higher median over-all incomes than those employed by government agencies and educational institutions, in all age groups above 30. At some age levels their earnings actually exceeded those of chemists in private industry (table A-25). These relatively high earnings are due primarily to the fact that a third of the chemists working for nonprofit foundations were Ph.D.'s. When both age and level of education are taken into account, it can be seen that chemists working for nonprofit foundations usually earn less than those in private industry with comparable qualifications although their earnings exceed those of government employees and faculty members (table A-26).

Industry

In this period of scientific manpower shortages when employers in different industries are frequently in competition for both recent graduates and experienced scientists, information on the incomes of chemists in the various branches of manufacturing is of particular interest.

The median income of the surveyed chemists in each age group and at each level of education, varied considerably between industries (table A-27). In general, incomes of chemists working for the chemical industries were high whereas those in the food industry and in the manufacture of machinery, tended to have incomes below the average for all chemists in manufacturing.

Among the Ph.D.'s, the highest paid group was the chemists in consulting laboratories and other professional service organizations. The masters and bachelors working for such organizations, however, did not have this income advantage, possibly because fewer of them than of the Ph.D.'s were self-employed (table A-27).

The survey also shows that in each branch of manufacturing employing a sizable number of chemists, there is direct relationship between chemists' earnings and their level of education, as shown in table 4.

Table 4.--Annual income of chemists, by level of education and industry, 1951

Industry	Degree		
	Ph.D.	M.S.	B.S.
Food and kindred products	$8,700	$5,800	$4,800
Paper and allied products	8,700	5,600	5,300
Chemicals and allied products ...	7,900	6,000	5,200
Rubber products	7,700	5,800	5,500
Machinery (except electrical) ...	7,400	6,000	4,700
Electrical machinery	7,100	5,700	4,900
Professional and scientific instruments	8,100	6,200	5,200
Miscellaneous consulting and other business services	9,600	5,700	5,000
Petroleum refining	8,000	6,100	5,600

It can thus be seen that, no matter where they may be employed, chemists with graduate degrees, and especially Ph.D.'s tend to have a consistent earnings advantage over those who have made less of an educational investment.

Income of Women Chemists

The information regarding the income of women chemists provided by this study is one of its major contributions seeing that this is the first time comprehensive data have been compiled on the earnings of women scientists in the United States.

The study reveals sharp differences in earnings between men and women chemists. The male members of the profession had a median annual income of $5,700 in mid-1951, the women a median of only $3,700. The difference between the earnings of the two sexes was smaller for the groups at the lower end of the income scale, but greater at the upper income levels, as shown by the following annual income figures: 18/

18/ For detailed figures on the income distribution of women by age group, see table A-28.

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	Men	Women
Median income	$5,700	$3,700
Lower quartile income	4,400	3,000
Upper quartile income	7,600	4,500

In part, these income differentials were due to the fact that the women chemists in this survey tended to be younger than the men, and that fewer of them had Ph.D.'s. However, in each age group and at each level of education, the women had considerably lower average incomes than the men (chart 6 and table A-29). For example, among chemists aged 30-34 years holding only bachelor's degrees, the median income for men was $5,200, for women only $4,100. In the older age groups, the gap was even wider. Thus, the women aged 50-54 years holding only bachelor's degrees had a median income of $4,500, whereas the median for the parallel group of men was almost twice as high--$8,300 a year.

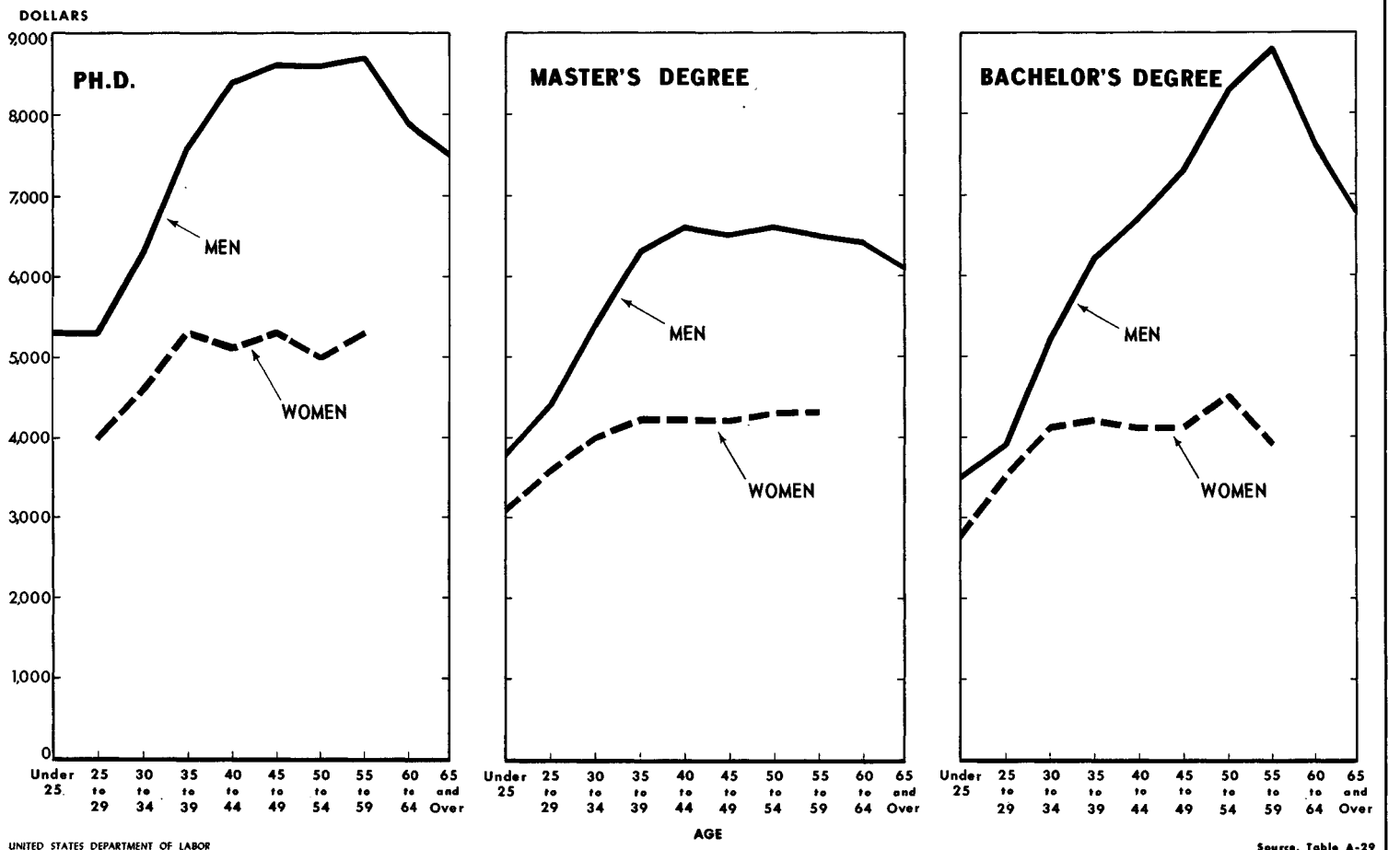
In every type of employment--in private industry, in educational institutions, and in the government--the women tended to earn less than men of comparable age and education (insofar as this can be determined from available data). 19/ In private industry, the men with bachelor's degrees had consistently higher average earnings than the women at that level of education, as shown by the following median income figures:

Age group	B.S. chemists in private industry	
	Men	Women
Under 25 years	$3,600	$3,100
25 - 29 years	4,100	3,700
30 - 34 years	5,300	4,200
35 - 39 years	6,400	4,500
40 - 44 years	7,100	4,300

19/ Because the total number of women in the survey was limited, the numbers in many categories became very small when the data were cross-classified by age, level of education, and type of employer. It was possible to compute median incomes for women in a series of age groups only for those with bachelor's degrees employed in private industry and those with Ph.D.'s in educational institutions. In addition, median incomes for women with master's degrees in different types of employment could be computed for a few age groups; a comparison of these fragmentary data with comparable figures for men confirms the finding that men chemists have consistently higher incomes than women.

Chart 6. Women Chemists Have Lower Incomes Than Men, Especially in the Older Age Groups

MEDIAN INCOME OF MEN AND WOMEN CHEMISTS, BY AGE AND LEVEL OF EDUCATION, 1951



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Source. Table A-29

Likewise, among Ph.D.'s in educational institutions, men chemists had a consistent income advantage, as shown in the following data on median earnings:

Age group	Ph.D. chemists in educational institutions	
	Men	Women
25 - 29 years	$4,400	$4,000
30 - 34 years	5,000	4,000
35 - 39 years	5,800	(1/)
40 - 44 years	6,400	4,500
45 - 49 years	6,500	5,000
50 - 54 years	6,800	4,300
55 - 59 years	7,000	5,100

1/ Too few to compute median.

In interpreting these data on the earnings of men and women chemists, it is important to note that the figures presented represent total annual professional income, and that men usually have better opportunities than women to supplement their salaries by working as consultants, lecturing, or carrying on other professional activities. The general findings of the study suggest, however, that income differences between men and women chemists are due largely to the fact that women have fewer opportunities for employment and, above all, for professional advancement than men.

PART 2 - CHEMICAL ENGINEERS

Labor Supply in Chemical Engineering

Fields of Specialization

Chemical engineering developed as a profession when the industrial uses of chemistry reached a scale requiring the application of engineering principles. There are no well-defined subdivisions of the field of chemical engineering. A chemical engineer may specialize, however, either in terms of a particular industry or product or a particular type of operation.

The questionnaire used in the present survey included a list of operational specialties in chemical engineering (such as phase change separation, heat transmission, and measurement and control of process variables), and close to 5,700 respondents cited areas in this list as their fields of highest competence. A smaller group (under 2,700) indicated that they were specialists in a product (such as rubber or petroleum) rather than an engineering process. 20/ The remaining 4,950 respondents classified themselves as general chemical engineers. Table A-30 gives the number and percent of chemical engineers who listed each operational capacity.

Women Chemical Engineers

Women who are interested in careers in the field of chemistry almost always become chemists rather than chemical engineers. Only 37 of the 13,342 chemical engineers in the survey were women, compared with about 3,900 (7 percent) of the surveyed chemists.

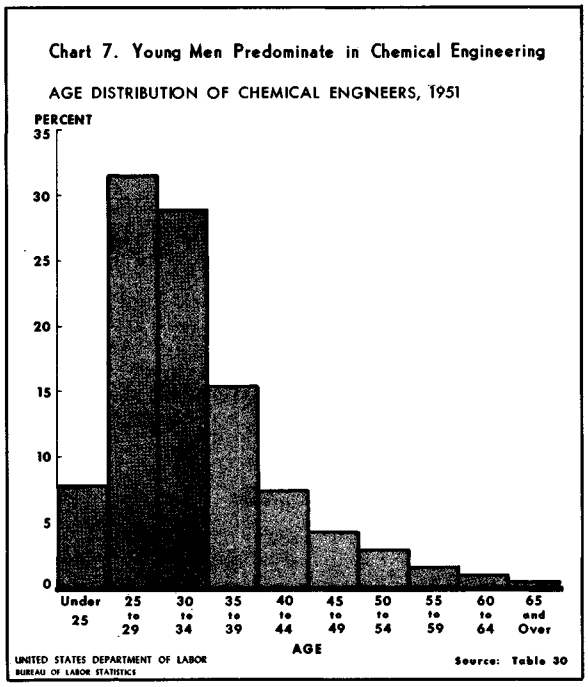
20/ In filling out a questionnaire in this survey, the chemical engineer was given the alternative of checking, as his field of highest competence, either one of the operational specialties included in the chemical engineering section of the specialty check list or one of the specialties in the chemistry section of the list, which was organized on a product basis. Altogether, 2,678 respondents who were currently employed in chemical engineering and whose highest degrees were in that field checked a specialty in this latter section of the list, usually a product specialty. These respondents are included under the category "other" engineering specialties in table A-1.

Age

Chemical engineers are one of the youngest professional groups in the United States. The median age of those in the current survey was 32 years. Two out of three were under 35, and more than 80 percent were under 40 (tables A-31 and chart 7).

Men in this branch of engineering tend to be younger than chemists and other engineers. The median age of the chemists in this 1951 study was 3 years above that of the chemical engineers. For other branches of the engineering profession, the most recent source of comparative data is a 1946 survey conducted by the Bureau in cooperation with the Engineers Joint Council. 21/ At the time of that study, as in 1951, the median age of chemical engineers was about 32 years. The next youngest group, the mechanical engineers, had a median age of approximately 36 years. The median for civil engineers, who were the oldest group, was about 45.

Chart 7. Young Men Predominate in Chemical Engineering



Citizenship Status

The chemical engineers in this survey--like their colleagues, the chemists--were native-born American citizens in the great majority of cases (96 percent). Only 374 of them (3 percent) were naturalized citizens. An even smaller proportion (1 percent) were aliens, and most of these were in process of naturalization.

Military Status

The proportion of reservists was higher among the surveyed chemical engineers than among the chemists--one out of four as compared with one out of seven. There were 3,275 members of reserve organizations among the 13,115 surveyed men chemical engineers who reported military status. Most of the reservists were between 26 and 35 years of age, as shown in table 5.

21/ Employment Outlook for Engineers, (p. 108), Bulletin No. 968, 1949. This study gives figures for median years of experience only; median ages are arrived at by adding 23 years to these figures.

Table 5.--Military status of chemical engineers, by age, 1951

Military status	Under 26 years		26-34 years		35 years and over	
	Number	Percent	Number	Percent	Number	Percent
Total	1,615	100.0	7,325	100.0	4,175	100.0
On active duty	165	10.2	80	1.1	16	0.4
In reserve organizations....	346	21.4	2,447	33.4	482	11.5
Other military status 1/	5	.3	27	.4	11	.3
No present military status:						
Veteran	617	38.2	2,542	34.7	428	10.3
Nonveteran	482	29.9	2,229	30.4	3,238	77.5

1/ Such as Retired and Fleet Reserve.

Table 5 shows that a substantial group (10 percent) of the chemical engineers under 26 years of age were on active duty with the Armed Forces. As in the case of chemists, the majority of chemical engineers on active duty were draftees rather than reservists.

Of the 261 chemical engineers in the Armed Forces only 69 reported that they were doing scientific work. The rest included some who failed to report the nature of their assignment as well as those doing nonscientific work.

Detailed figures on the military status of chemical engineers and graduate students are given in tables A-32 and A-33. As shown in table A-33, about the same proportion of graduate students (26 percent) as of experienced chemical engineers were members of reserve organizations.

Level of Education

Although graduate training has made greater headway in chemical engineering than in any other major engineering specialty, the baccalaureate is still the characteristic degree in this profession. Seventy-one percent of the surveyed chemical engineers held only bachelor's degrees. The proportion with master's or second professional degrees was 20 percent, slightly higher than the corresponding figure for chemists. However, only 7 percent of the engineers--in contrast to 24 percent of the chemists--held Ph.D.'s. In the entire chemical engineering profession, the relative number with doctorates was considerably lower than among the engineers in this

survey, which had a disproportionately high coverage of Ph.D.'s among chemical engineers as well as among chemists.

Extremely few men have entered chemical engineering in recent years without formal training. All but 2 percent of the surveyed engineers had college degrees, and there was only 1 individual, among the 13,258 in the survey, who had never attended college. Furthermore, the small number of engineers without a college degree were the oldest group in the survey; their median age was 38, 6 years above the average for the profession as a whole.

Among engineers who were college graduates, there was a direct relationship between average age and extent of academic training. The median age of engineers with Ph.D.'s was 37 years, compared with a median of 32 for the masters and 31 for the bachelors (table A-3).

Major Subject for Highest Degree

Even fewer chemical engineers than chemists enter their profession from other fields of study. Nine out of 10 engineers in this survey had obtained their highest degrees in chemical engineering, whereas only 3 out of 4 chemists had taken their most advanced training in chemistry. Only 3 percent of the chemical engineers, compared with 10 percent of the chemists, held their highest degrees in subjects outside both these disciplines (table A-34). Furthermore, many more of the respondents had moved from training in chemical engineering into specialization in chemistry than had shifted in the opposite direction--no doubt, because few chemistry students take courses in chemical engineering, whereas the chemical engineering curriculum includes extensive training in chemistry.

This generalization with regard to shifts between chemistry and chemical engineering held true for holders of bachelor's and master's degrees. Among Ph.D.'s, however, the situation was reversed. Only 2 percent of the Ph.D. chemists had taken their doctorates in chemical engineering, but 19 percent of the chemical engineers with Ph.D.'s had earned these degrees in chemistry. Undoubtedly, many of the men in the latter group held bachelor's or master's degrees in engineering or had minored in chemical engineering at the Ph.D. level.

The finding that, except at the Ph.D. level, extremely few men are entering chemical engineering from other fields is confirmed by an analysis of the subjects in which graduate students had taken the highest degrees so far attained. Of the 977 chemical engineering students in the survey, only 77 had taken their most advanced degrees in other subjects. Fifty-seven of these had majored in chemistry.

Employment

Fields of Employment

The fact that chemical engineering provides the chemistry profession with more recruits than it receives is indicated by the data on fields of training given in the preceding section. A comparison of the fields in which the surveyed engineers and scientists were currently employed with those in which they were most competent points to the same conclusion. Seven percent of the surveyed chemical engineers were employed as chemists, whereas only about 1 percent of the respondents whose field of highest competence was in chemistry held jobs in chemical engineering.

In addition to the group working in chemistry, a few chemical engineers (1 percent of the total) were employed in other engineering and scientific fields, and 2 percent were in nonscientific fields. However, the great majority (90 percent) held jobs in chemical engineering in mid-1951. The remainder of this report is concerned only with these engineers and does not cover the small group with jobs in chemistry or other fields.

Industries Where Employed

It follows from the nature of chemical engineers' work--which is concerned primarily with the industrial applications of chemistry--that members of this profession are employed predominantly in manufacturing industries. Eighty-four percent of the surveyed chemical engineers had jobs in manufacturing industries, an even higher proportion than of the chemists (67 percent). In addition, a few of the reporting engineers were working for public utilities, mining and construction companies, engineering consulting firms, and business concerns of other types. Altogether, at least 9 out of every 10 were in private industry. The relative numbers employed by Federal, State, and local government agencies and by educational institutions were small (4 percent in each case). 22/

The branch of manufacturing employing the largest number of chemical engineers is the chemical industries (table A-35). Of the engineers with jobs in the manufacturing industries at the time

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22/ According to a 1951 survey of Federal employment conducted by the U. S. Civil Service Commission, a total of 1,148 persons were employed in chemical engineering positions (including 55 classified as ceramic engineers) as of June 30, 1951.

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of this 1951 survey, 48 percent were on the chemicals industries' payrolls--a considerably higher proportion than in 1946 (42 percent). This increase, like the parallel increase in employment of chemists, was a reflection of the great expansion of the chemicals industries in recent years.

Both in 1946 and 1951, the petroleum and coal products industries employed many more chemical engineers than any other branch of manufacturing except chemicals and allied products, as shown in table 6.

Table 6.--Percent of chemical engineers employed in manufacturing industries, 1946 and 1951

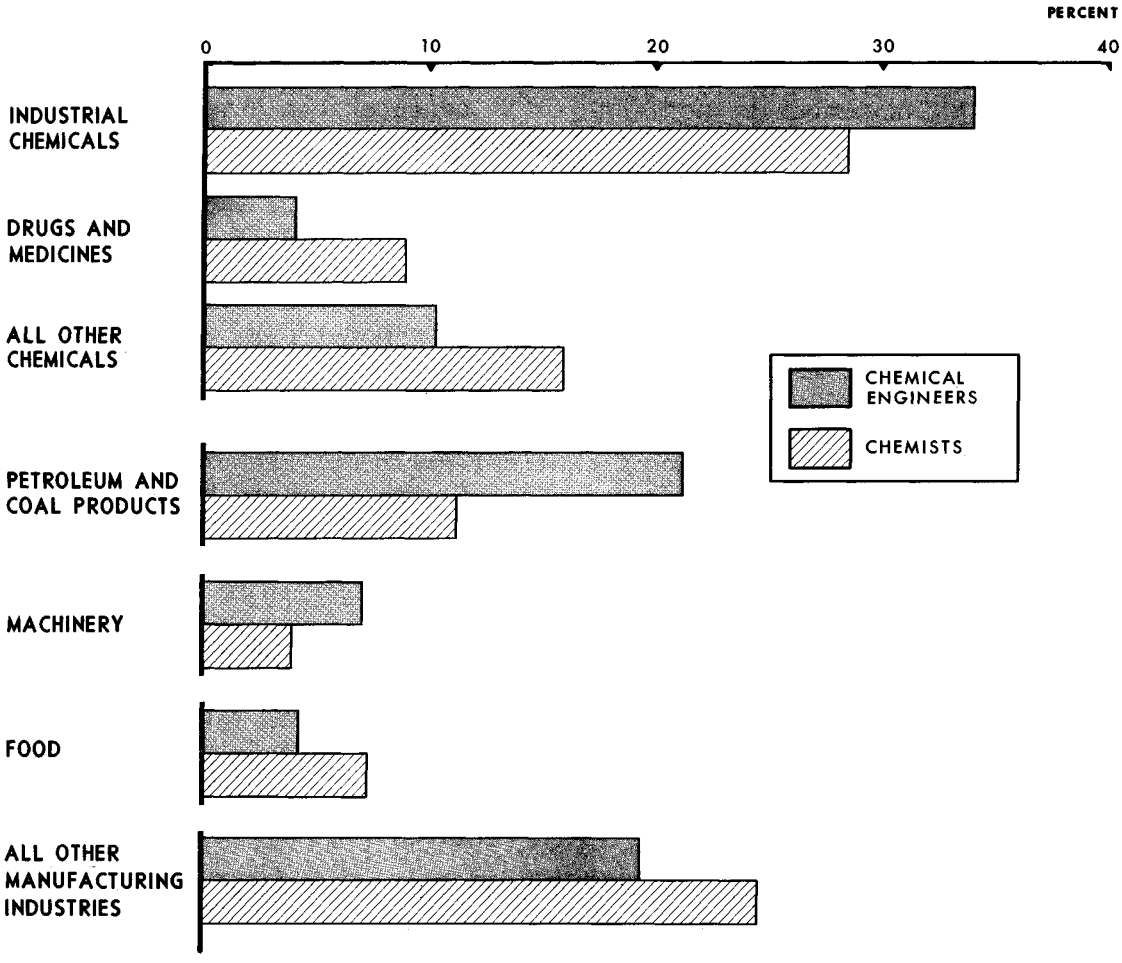
Branch of Manufacturing	1951	1946
Food and textiles	5.1	6.3
Lumber, furniture, and paper	3.6	4.8
Printing and publishing	.2	1.6
Chemicals and allied products	48.3	42.1
Petroleum and coal products	21.2	25.1
Rubber, stone, clay, and glass	4.1	7.6
Iron, steel, and nonferrous metals ..	2.0	4.1
Machinery including electrical	6.9	3.2
Transportation equipment	.8	1.2
Other manufacturing industries	7.8	4.0
Total	100.0	100.0

The outstanding difference between chemical engineers and chemists with respect to the proportions employed in various manufacturing industries was in petroleum and coal products. The relative number employed in that industry was almost twice as high among chemical engineers as among chemists. There were two other industries--industrial chemicals and machinery (except electrical)--in which employment was more frequent among chemical engineers than among chemists. However, the situation was reversed in the manufacture of drugs and medicines, food and kindred products, and of rubber products (chart 8).

Only among the chemical engineers who held Ph.D.'s were jobs outside of manufacturing industries a signficant source of employment; 30 percent of the Ph.D.'s were employed in educational institutions, compared with 6 percent of the masters and fewer than 1 percent of the bachelors. Government agencies employed a small proportion of the surveyed chemical engineers at each level of education (table A-36).

Chart 8. Relatively More Chemical Engineers Than Chemists Work in the Petroleum and Industrial Chemicals Industries

PERCENT OF ALL CHEMISTS AND CHEMICAL ENGINEERS EMPLOYED IN SELECTED BRANCHES OF MANUFACTURING, 1951



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Source: Tables 13 and 35

Function

Most chemical engineers are employed either in research and development or in production work. Thirty-one percent of the surveyed engineers reported that they were engaged primarily in research and development, 28 percent that they were employed chiefly in production.

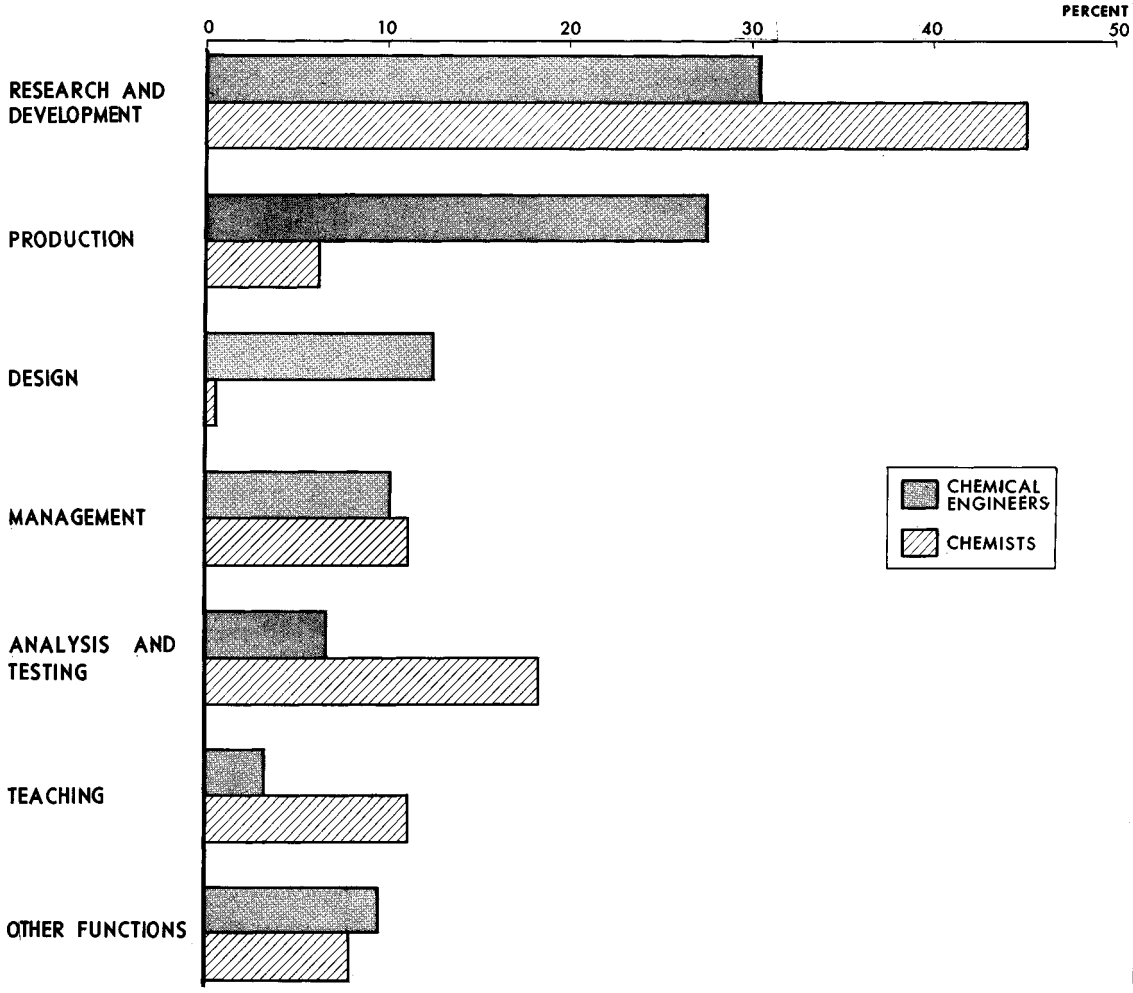
The relative number of men engaged in research and development is much greater among chemical engineers than among engineers in most other specialties. 23/ On the other hand, it will be recalled that an even higher percentage of the surveyed chemists (45 percent) than of the chemical engineers reported research and development as their chief function. Another type of activity which employed relatively more chemists than chemical engineers was analysis and testing, whereas design and production are the domain primarily of the chemical engineer (chart 9).

Owing to the specialized requirements of the various types of employers, the relative number of chemical engineers performing different functions varied from one area of employment to another (table A-37). In government agencies, where production and related activities are of minor importance, more than half of the chemical engineers were doing research and development work. In manufacturing industries as a whole, the same proportion of engineers were engaged in production as in research and development (31 percent in each case), with much smaller numbers in other types of work, but the picture was quite different in some industries. In the machinery industry, for example, one-third of the engineers were doing design work, and the proportion employed in technical sales and service was also relatively high (19 percent). It appears that machinery manufacturers employ chemical engineers primarily to design, sell, and service equipment for the chemical and related industries.

23/ See, Employment Outlook for Engineers, (p. 104), Bulletin No. 968, U. S. Department of Labor, Bureau of Labor Statistics; also, Employment, Education, and Income of Engineers, 1949-50, U. S. Department of Labor, Bureau of Labor Statistics. The latter study was based on a questionnaire survey of the senior members of engineering societies. Of the chemical engineers covered by the report, all of whom were senior members of the American Institute of Chemical Engineers, 19 percent reported research and 17 percent reported development as their primary function. In all engineering fields taken together, only 7 percent of the reporting engineers were engaged in research and 9 percent in development.

Chart 9. Relatively Fewer Chemical Engineers Than Chemists Are in Research, and More Do Production and Design Work

PERCENT DISTRIBUTION OF CHEMISTS AND CHEMICAL ENGINEERS, BY FUNCTION, 1951



UNITED STATES DEPARTMENT OF LABOR
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Source: Tables 18 and 37

In chemical engineering, as in chemistry, holders of graduate degrees tend to be employed in research and development work to a greater extent than those who have not gone beyond the baccalaureate. The latter group, on the other hand, are more likely to be employed in production work than those with more advanced training (table A-38).

Although every function was performed by some respondents in each age group, among both chemical engineers and chemists, research, development, and production work were more often carried out by the younger than the older men (table A-39). Management and teaching, on the other hand, were characteristically activities of the engineers over 35. Close to three-fourths of the men who had obtained managerial positions had passed their thirty-fifth birthday and so had more than half the teachers (table A-39).

Income

The chemical engineers in this survey had a median annual professional income of $5,600 in mid-1951. Three out of four earned at least $4,400 (the lower quartile), and one out of four earned over $7,300 (the upper quartile). 24/ Because of the acute shortage of personnel in this field in 1951-52, incomes of chemical engineers have undoubtedly increased since the time of the survey. 25/

In 1943, the median professional income of the chemical engineers was approximately $4,000, according to the BLS survey

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24/ These figures represent total annual professional incomes, including fees, royalties, and other professional earnings in addition to salaries. They cover only chemical engineers working as such at the time of the survey, of whom 80 percent furnished information on income. The income question was the same for both chemists and chemical engineers and is described on page 29.

The findings with respect to chemical engineers' income are not significantly affected by the survey's disproportionately high coverage of Ph.D.'s because the total number of the latter group involved is so small.

25/ The median earnings in March 1952 of a group of chemical engineers in the New York-New Jersey area was $7,300, according to a survey by the New York and New Jersey sections of the American Institute of Chemical Engineers. The report of this survey stresses, however, that earnings of engineers for the metropolitan New York area are considerably higher than for the country as a whole. See "The American Engineer --A Regional Survey," Chemical Engineering Progress, August 1952.

previously cited. 26/ A comparison of the findings of this earlier study with those of the present survey points to an increase of about 40 percent in over-all median incomes of chemical engineers between 1943 and 1951. It suggests, further, that the incomes of experienced engineers have increased relatively more than those of beginners.

Age

A steady rise in average income with increasing age and experience was recorded for the engineers in the present study. Median earnings mounted progressively, from $3,700 for the men under 25 years of age to $11,700 for the 60-64 year-old group and a still higher figure (more than $15,000) for the very small number of engineers aged 65 or over who supplied income information (table A-40).

At every age level, the chemical engineers tended to earn more than the chemists in the survey, but the difference in median income between the two professions was no more than $500 in the age groups under 35. After that age, the differential widened sharply, reaching $3,500 among the respondents between 55 and 60. Past 60, the chemists' earnings tended to decline, whereas those of the chemical engineers continued to rise--leading, of course, to a still greater difference in average earnings between the two professions. This is indicated in table 7.

Table 7.--Annual income of chemists and chemical engineers, by age group, 1951

Age group	Chemists	Chemical engineers
All ages	$5,500	$5,600
Under 25 years	3,400	3,700
25 - 29 years	4,100	4,600
30 - 34 years	5,400	5,900
35 - 39 years	6,500	7,300
40 - 44 years	7,000	8,100
45 - 49 years	7,300	9,800
50 - 54 years	7,800	11,000
55 - 59 years	7,900	11,400
60 - 64 years	7,400	11,700
65 years and over	6,800	15,000/

26/ See Factors Affecting Earnings of Chemists and Chemical Engineers, (p. 11), U. S. Department of Labor, Bureau of Labor Statistics.

Level of Education

The earnings of chemical engineers, like those of chemists, are influenced not only by the individual's age and experience but also by the amount of formal training received. Among the engineers in this survey, the median earnings of the Ph.D.'s were $7,900, those of the masters $5,900, and those of the bachelors $5,400. The small group of engineers without a college degree had a median income of $6,100 (table A-41). However, the apparent advantage of those who had not completed college disappears when age is taken into account: In most age groups, bachelors and masters had consistently higher incomes than chemical engineers without a college degree. The median and quartile incomes of chemical engineers aged 30-34 years is shown below, to illustrate the range of incomes among the various levels of education:

	Median	Lower quartile	Upper quartile
Ph.D.	$6,700	$5,700	$7,900
Master's degree	6,100	5,200	7,200
Bachelor's degree	5,800	4,900	6,800
No degree	5,100	4,400	5,900

The tendency for chemical engineers to earn more than chemists held true at every age level for persons of comparable educational background. So important was this difference in earnings that, among the surveyed scientists aged 45 and over, chemical engineers with only bachelor's degrees had higher median earnings than chemists with Ph.D.'s (table A-42).

Type of Employer

Chemical engineers employed in private industry tend to have higher incomes than the small groups in other types of employment. At every age level, the government workers were the group with the lowest median incomes, but the income differences were small among the younger men. Thus, chemical engineers aged 25 to 29 had a median annual income of $4,000 in government agencies, compared with $4,300 in educational institutions and $4,600 in private industry. For those aged 40 to 44, on the other hand, the median annual income of the government employees was $6,100, compared with $8,100 for the educators and $8,200 for the engineers in private industry (table A-43).

As these figures indicate, the educators had a considerably higher average income than the government workers, taking all ages together, and in some age groups they had only slightly lower earnings than private industry employees. One of the main reasons for the

relatively high earnings of the chemical engineers on the campus was their educational background. Three-fifths of the surveyed faculty members held Ph.D. degrees and more than one-fourth had master's degrees, much higher proportions than in either government or private industry. It must be noted that the earnings reported here included not only salaries but also supplementary earnings from such sources as consulting fees and royalties. The relatively high earnings reported by chemical engineers on college faculties are no doubt due in some measure to the opportunities they have for consulting and other outside work.

Industry

The two branches of manufacturing which employ the largest numbers of chemical engineers--the chemicals and petroleum industries--are also those where earnings in this profession tend to be highest. Among the surveyed engineers whose highest degree was the B. S., only the relatively small group employed in engineering, consulting, and other business services, (many of whom are self-employed) had higher median earnings at all age levels than those working in chemicals and in petroleum refining (table A-44). In other manufacturing industries employing substantial numbers of chemical engineers, such as the primary metals industry, electrical machinery, stone, clay and glass products, food, and paper, median incomes were considerably lower. The following median income figures,for chemical engineers between the ages of 30 and 35, illustrate this point.

Industry	Median income
Food and kindred products	$5,300
Paper and allied products	5,300
Chemicals and allied products	6,000
Stone, clay, and glass products	5,400
Primary metals	5,800
Machinery (except electrical)	5,900
Electrical machinery	5,400
Professional and scientific instruments	5,700
Petroleum refining	6,000
Engineering and consulting services	6,900

The survey findings with respect to differences in income between industries are similar for chemists and chemical engineers. In both professions, industrial differences in median earnings become sizable in the age groups past 40 and, especially in the chemicals industries, the older men have a distinct income advantage.

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Table A-1.--Distribution of chemistry respondents, by employment status and field of highest competence, 1951

Field of highest competence	Employed		Unemployed		Graduate students		Retired	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
All fields	51,155	100.0	122	100.0	5,880	100.0	686	100.0
General chemistry	2,568	5.0	45	36.9	1,503	25.6	84	12.2
Analytical chemistry..	6,797	13.3	17	13.9	509	8.7	110	16.0
Agricultural and food chemistry	3,109	6.1	3	2.5	109	1.8	72	10.5
Biochemistry	2,824	5.5	6	4.9	605	10.3	52	7.6
Inorganic chemistry...	4,658	9.1	4	3.3	247	4.2	81	11.8
Organic chemistry	23,608	46.1	36	29.5	1,878	31.9	227	33.1
Pharmaceutical chemistry	2,221	4.4	2	1.6	101	1.7	26	3.8
Physical chemistry ...	4,115	8.0	7	5.8	911	15.5	22	3.2
Other chemistry specialties 1/	1,255	2.5	2	1.6	17	.3	12	1.8

1/ Includes water, sewage, and sanitation chemistry; chemical warfare agents; industrial wastes; and food processing (such as concentration, drying, and refrigeration).

Table A-2.--Distribution of chemists, by area of concentration within field of highest competence, 1951 1/

Field of highest competence	Number	Percent
All fields	51,277	100.0
Chemistry, general	2,613	5.1
Analytical chemistry	6,814	13.3
General analytical chemistry	3,249	6.3
Assaying	722	1.4
Classical methods	1,353	2.7
Electrochemical methods	184	.4
Forensic chemistry	56	.1
Microchemistry	306	.6
Optical methods	536	1.0
Tracer methods	85	.2
Instrumental methods	83	.2
Other	72	.1
Spectroscopy	168	.3
Agricultural and food chemistry	3,112	6.1
General agricultural and food chemistry	1,419	2.8
Fermentation products	518	1.0
Food chemistry	259	.5
Insecticides and pesticides	406	.8
Soils and fertilizers	310	.6
Dairy products, fats, oils	50	.1
Phytochemistry	37	.1
Fruits and vegetables	22	(2/)
Meats, sea food, and poultry	17	(2/)
Other	74	(2/)
Biochemistry	2,830	5.5
General biochemistry	692	1.3
Clinical	517	1.0
Endocrine	112	.2
Enzyme	465	.9
Microbiological	157	.3
Nutrition	542	1.1
Organic	77	.2
Biochemistry-Continued.		
Physical	137	.3
Technology	64	.1
Other	67	.1
Inorganic chemistry	4,662	9.1
General inorganic chemistry	710	1.4
Cement, concrete, and related building materials	316	.6
Fine chemicals	171	.3
Geological and mineralogical chemistry	76	.1
Glass, clay products, refractories	302	.6
Heavy chemicals	848	1.7
Fluorescent materials	42	.1
Industrial and other gases	179	.3
Metals	821	1.6
Pigments (including carbon black)	387	.8
Radioactive materials	409	.8
Theoretical inorganic chemistry	228	.5
Other	173	.3
Organic chemistry	23,644	46.1
General organic chemistry	2,011	3.9
Adhesive, glues, and sizes	490	1.0
Carbohydrates	301	.6
Coal and coal products	395	.8
Dyes and inks	924	1.8
Explosives and rocket fuels	556	1.1
Fine chemicals	454	.9
Heavy chemicals	218	.4
Leather and tanning materials	237	.5

Table A-2.--Distribution of chemists, by area of concentration within field of highest competence, 1951 1/ (Continued)

Field of highest competence	Number	Percent	Field of highest competence	Number	Percent
Organic chemistry-Continued.			Physical chemistry-Continued.		
Natural and synthetic rubber and related products	2,154	4.2	Atomic and nuclear structure, and radiochemistry	355	.7
Natural and synthetic textiles and related products	1,229	2.4	Colloid chemistry	334	.7
Oils, fats, and waxes	886	1.7	Electrochemistry and dielectrics	654	1.3
Organic synthesis	2,698	5.2	Explosives and rocket fuels	202	.4
Paints, enamels, and varnishes	1,742	3.4	Photochemistry	351	.7
Petroleum byproducts	1,087	2.1	Theoretical physical chemistry	558	1.0
Petroleum products	2,534	4.9	Thermodynamics	322	.6
Resins and plastics	2,455	4.7	Ion exchange and applications	38	.1
Soaps and detergents	754	1.5	Catalysts	119	.2
Synthetic alcohols and solvents	295	.6	Corrosion and inhibition	115	.2
Theoretical organic chemistry	398	.8	Vacuum techniques	19	(2/)
Wood, paper, pulp, and lignin	1,345	2.6	Other	99	.2
Organo-metallic compounds	19	(2/)	Other chemistry specialties	1,257	2.5
Silicon compounds	79	.2	Chemical warfare agents	139	.3
Halogen compounds	46	.1	Industrial wastes	152	.3
Protein and amino acids	81	.2	Water, sewage, and sanitation	804	1.6
Other	256	.5	Food packaging	24	.1
			Fiber and wood	2	(2/)
Pharmaceutical chemistry	2,223	4.3	Metal	8	(2/)
General pharmaceutical chemistry	522	1.0	Outer packing	2	(2/)
Cosmetics	201	.4	Plastics	2	(2/)
Natural and synthetic drugs	1,376	2.7	Food processing	36	.1
Pharmacology	102	.2	Concentrating and drying	5	(2/)
Other	22	(2/)	Equipment	2	(2/)
			Thermal processing	2	(2/)
Physical chemistry	4,122	8.0	Other	79	.1
General physical chemistry	763	1.5			
Absorption and adsorption.	193	.4			

1/ In this and the following tables through table A-28, the term "chemist" refers to all employed and unemployed respondents with a field of highest competence in chemistry.

2/ Less than 0.05 percent.

Table A-3.--Fields of highest competence of men and women chemists, 1951

Field of highest competence	Total		Men		Women	
	Number	Percent	Number	Percent	Number	Percent
All fields	51,277	100.0	47,408	100.0	3,869	100.0
General chemistry	2,613	5.1	2,082	4.4	531	13.7
Analytical chemistry	6,814	13.3	5,913	12.5	901	23.3
Agricultural and food chemistry	3,112	6.1	2,893	6.1	219	5.7
Biochemistry	2,830	5.5	2,188	4.6	642	16.6
Inorganic chemistry	4,662	9.1	4,469	9.4	193	5.0
Organic chemistry	23,644	46.1	22,677	47.8	967	25.0
Pharmaceutical chemistry	2,223	4.3	2,059	4.3	164	4.2
Physical chemistry	4,122	8.0	3,922	8.3	200	5.2
Other chemistry specialties 1/	1,257	2.5	1,205	2.6	52	1.3

1/ Includes water, sewage, and sanitation chemistry; chemical warfare agents; industrial wastes; and food processing (such as concentration, drying, and refrigeration).

Table A-4.--Age of chemists, by field of highest competence, 1951

Age group	All fields	General	Analytical	Agricultural and food	Inorganic	Organic	Pharmaceutical	Physical	Biochemistry	Other 1/
	Number									
Under 25 years	3,143	526	619	149	191	1,068	115	191	202	82
25 - 29 years	10,433	609	1,751	517	846	4,608	415	923	517	247
30 - 34 years	12,002	271	1,591	594	1,006	6,009	515	1,166	637	213
35 - 39 years	8,989	243	963	525	768	4,659	418	722	452	239
40 - 44 years	5,943	243	707	408	573	2,828	271	412	339	162
45 - 49 years	4,049	234	450	300	422	1,824	190	287	229	113
50 - 54 years	2,862	199	297	235	336	1,192	124	200	194	85
55 - 59 years	2,016	139	218	203	248	813	80	118	142	55
60 - 64 years	1,132	88	132	113	159	426	55	60	63	36
65 years and over ...	634	60	80	62	99	189	36	34	51	23
Total number reporting.	2/51,203	2,612	6,808	3,106	4,648	23,616	2,219	4,113	2,826	1,255
	Percent									
Under 25 years	6.1	20.1	9.1	4.8	4.1	4.5	5.2	4.6	7.1	6.5
25 - 29 years	20.4	23.3	25.7	16.7	18.2	19.5	18.7	22.4	18.3	19.7
30 - 34 years	23.5	10.4	23.4	19.1	21.7	25.5	23.2	28.3	22.6	17.0
35 - 39 years	17.6	9.3	14.1	16.9	16.5	19.7	18.8	17.6	16.0	19.0
40 - 44 years	11.6	9.3	10.4	13.1	12.3	12.0	12.2	10.0	12.0	12.9
45 - 49 years	7.9	9.0	6.6	9.7	9.1	7.7	8.6	.7.0	8.1	9.0
50 - 54 years	5.6	7.6	4.4	7.6	7.2	5.0	5.6	4.9	6.9	6.8
55 - 59 years	3.9	5.3	3.2	6.5	5.4	3.5	3.6	2.9	5.0	4.4
60 - 64 years	2.2	3.4	1.9	3.6	3.4	1.8	2.5	1.5	2.2	2.9
65 years and over ...	1.2	2.3	1.2	2.0	2.1	.8	1.6	.8	1.8	1.8
All ages	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Median age	35	33	33	38	37	35	36	34	36	37

1/ Includes water, sewage, and sanitation chemistry; chemical warfare agents; industrial wastes; and food processing (such as concentration, drying, and refrigeration).

2/ Excludes 74 chemists not reporting age.

Table A-5.--Age of men and women chemists, and graduate students of chemistry, 1951

Age group	Percent			
	Chemists			Graduate students in chemistry
	Total	Men	Women	
Under 25 years	6.1	4.8	21.5	37.0
25 - 29 years	20.4	19.2	35.2	48.0
30 - 34 years	23.5	24.3	13.4	12.6
35 - 39 years	17.6	18.3	8.2	1.7
40 - 44 years	11.6	12.0	6.3	.5
45 - 49 years	7.9	8.1	5.5	.1
50 - 54 years	5.6	5.7	4.7	.1
55 - 59 years	3.9	4.0	3.4	(1/)
60 - 64 years	2.2	2.3	1.2	--
65 years and over ...	1.2	1.3	.6	--
All ages	100.0	100.0	100.0	100.0
Total number reporting	2/51,203	47,336	3,867	5,880
Median age	35	35	29	26

1/ Less than 0.05 percent.
2/ Excludes 74 chemists (72 men and 2 women not reporting age).

Table A-6.--Citizenship status of chemists, by field of highest competence, 1951

Field of highest competence	Total reporting		Citizen				Alien			
			Native-born		Naturalized		In process of naturalization		Not in process of naturalization	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
All fields	1/51,111	100.0	47,600	93.2	2,710	5.3	526	1.0	275	0.5
General chemistry	2,610	100.0	2,539	97.3	58	2.2	10	.4	3	.1
Analytical chemistry..	6,799	100.0	6,454	94.9	286	4.2	47	.7	12	.2
Agricultural and food chemistry	3,102	100.0	2,866	92.4	189	6.1	30	1.0	17	.5
Biochemistry	2,814	100.0	2,499	88.8	227	8.1	52	1.8	36	1.3
Inorganic chemistry ..	4,647	100.0	4,374	94.1	225	4.8	35	.8	13	.3
Organic chemistry	23,577	100.0	21,961	93.1	1,243	5.3	238	1.0	135	.6
Pharmaceutical chemistry	2,218	100.0	1,959	88.3	199	9.0	47	2.1	13	.6
Physical chemistry ...	4,090	100.0	3,744	91.5	242	5.9	61	1.5	43	1.1
Other chemistry specialties 2/	1,254	100.0	1,204	96.0	41	3.3	6	.5	3	.2

1/ Excludes 166 chemists who did not report citizenship status.

2/ Includes water, sewage, and sanitation chemistry; chemical warfare agents; industrial wastes; and food processing (such as concentration, drying, and refrigeration).

Table A-7.--Military status of men chemists, by age group, 1951

Age group	Total	On active duty	In reserve organizations	Other military status 1/	No present military status		
					Total	Veteran	Non-veteran
	Number						
All ages	2/ 46,257	914	7,050	145	38,148	11,243	26,905
20 - 25 years	3,625	461	673	6	2,485	1,308	1,177
20 years	5	1	--	--	4	--	4
21 years	47	9	2	--	36	--	36
22 years	274	48	45	2	179	4	175
23 years	872	249	108	4	511	49	462
24 years	1,089	98	256	--	735	490	245
25 years	1,338	56	262	--	1,020	765	255
26 - 34 years ...	19,039	346	4,600	58	14,035	6,928	7,107
26 years	1,552	52	316	1	1,183	874	309
27 years	1,823	50	403	2	1,368	1,033	335
28 years	2,032	46	563	6	1,417	1,042	375
29 years	2,259	43	678	6	1,532	978	554
30 years	2,458	48	666	8	1,736	918	818
31 years	2,476	30	662	15	1,769	723	1,046
32 years	2,068	25	469	9	1,565	544	1,021
33 years	2,276	35	509	7	1,725	471	1,254
34 years	2,095	17	334	4	1,740	345	1,395
35 - 39 years	8,513	62	1,056	25	7,370	793	6,577
40 - 44 years	5,547	19	382	12	5,134	321	4,813
45 - 49 years	3,689	13	174	14	3,488	171	3,317
50 - 54 years	2,566	7	96	2	2,461	585	1,876
55 - 59 years	1,772	6	54	12	1,700	829	871
60 - 64 years	975	--	10	8	957	236	721
65 years and over	531	--	5	8	518	72	446
Median age	35	26	32	36	37	31	39

See footnotes at end of table.

Table A-7.--Military status of men chemists, by age group, 1951 --Continued

Age	Total	On active duty	In reserve organizations	Other military status 1/	No present military status		
					Total	Veteran	Non-veteran
	Percent						
All ages	100.0	2.0	15.2	0.3	82.5	24.3	58.2
20 - 25 years ...	100.0	12.7	18.6	.1	68.6	36.1	32.5
20 years	(3/)	(3/)	--	--	(3/)	--	(3/)
21 years	100.0	19.1	4.3	--	76.6	--	76.6
22 years	100.0	17.5	16.4	.7	65.4	1.5	63.9
23 years	100.0	28.6	12.4	.4	58.6	5.6	53.0
24 years	100.0	9.0	23.5	--	67.5	45.0	22.5
25 years	100.0	4.2	19.6	--	76.2	57.1	19.1
26 - 34 years ...	100.0	1.8	24.2	.3	73.7	36.4	37.3
26 years	100.0	3.4	20.3	.1	76.2	56.3	19.9
27 years	100.0	2.7	22.1	.1	75.1	56.7	18.4
28 years	100.0	2.3	27.7	.3	69.7	51.3	18.4
29 years	100.0	1.9	30.0	.3	67.8	43.3	24.5
30 years	100.0	2.0	27.1	.3	70.6	37.3	33.3
31 years	100.0	1.2	26.8	.6	71.4	29.2	42.2
32 years	100.0	1.2	22.7	.4	75.7	26.3	49.4
33 years	100.0	1.5	22.4	.3	75.8	20.7	55.1
34 years	100.0	.8	15.9	.2	83.1	16.5	66.6
35 - 39 years ...	100.0	.7	12.4	.3	86.6	9.3	77.3
40 - 44 years ...	100.0	.3	6.9	.2	92.6	5.8	86.8
45 - 49 years ...	100.0	.4	4.7	.4	94.5	4.6	89.9
50 - 54 years ...	100.0	.3	3.7	.1	95.9	22.8	73.1
55 - 59 years ...	100.0	.3	3.1	.7	95.9	46.8	49.1
60 - 64 years ...	100.0	--	1.0	.8	98.2	24.2	74.0
65 years and over .	100.0	--	.9	1.5	97.6	13.6	84.0

1/ Such as Retired, Fleet Reserve, etc.

2/ Excludes 1,079 men chemists not reporting military status, 67 not reporting age, and 5 reporting neither.

3/ Too few to compute percentage.

Table A-8.—Military status of men graduate students of chemistry, by age group, 1951

Age group	Total	On active duty	In reserve organizations	Other military status 1/	No present military status		
					Total	Veteran	Non-veteran
	Number						
All ages	2/ 5,414	24	1,135	15	4,240	2,347	1,893
20 - 25 years ...	2,563	17	376	5	2,165	788	1,377
20 years	7	—	—	—	7	—	7
21 years	83	4	6	—	73	2	71
22 years	375	2	46	3	324	6	318
23 years	760	7	85	2	666	39	627
24 years	682	3	125	—	554	336	218
25 years	656	1	114	—	541	405	136
26 - 34 years ...	2,731	5	727	9	1,990	1,521	469
26 years	649	2	114	—	533	418	115
27 years	561	1	126	1	433	338	95
28 years	473	1	139	3	330	277	53
29 years	342	—	104	—	238	183	55
30 years	272	—	91	1	180	130	50
31 years	172	1	75	2	94	64	30
32 years	126	—	32	—	94	61	33
33 years	88	—	32	1	55	38	17
34 years	48	—	14	1	33	12	21
35 - 39 years ...	87	2	26	—	59	29	30
40 - 44 years ...	24	—	5	1	18	5	13
45 - 49 years ...	6	—	1	—	5	2	3
50 - 54 years ...	3	—	—	—	3	2	1
55 - 59 years ...	—	—	—	—	—	—	—
60 - 64 years ...	—	—	—	—	—	—	—
65 years and over	—	—	—	—	—	—	—
Median age	27	24	28	(3/)	26	27	24

See footnotes at end of table.

Table A-8.--Military status of men graduate students of chemistry, by age group, 1951--Continued

Age group	Total	On active duty	In reserve organizations	Other military status 1/	No present military status		
					Total	Veteran	Non-veteran
	Percent						
All ages	100.0	0.4	21.0	0.3	78.3	43.3	35.0
20 - 25 years	100.0	.7	14.7	.2	84.4	30.7	53.7
20 years	100.0	—	—	—	100.0	—	100.0
21 years	100.0	4.8	7.2	—	88.0	2.4	85.6
22 years	100.0	.5	12.3	.8	86.4	1.6	84.8
23 years	100.0	.9	11.2	.3	87.6	5.1	82.5
24 years	100.0	.4	18.3	--	81.3	49.3	32.0
25 years	100.0	.2	17.4	--	82.4	61.7	20.7
26 - 34 years	100.0	.2	26.6	.3	72.9	55.7	17.2
26 years	100.0	.3	17.6	—	82.1	64.4	17.7
27 years	100.0	.2	22.5	.2	77.1	60.2	16.9
28 years	100.0	.2	29.4	.6	69.8	58.6	11.2
29 years	100.0	—	30.4	—	69.6	53.5	16.1
30 years	100.0	—	33.5	.3	66.2	47.8	18.4
31 years	100.0	.6	43.6	1.2	54.6	37.2	17.4
32 years	100.0	--	25.4	--	74.6	48.4	26.2
33 years	100.0	—	36.4	1.1	62.5	43.2	19.3
34 years	100.0	—	29.2	2.1	68.7	25.0	43.7
35 - 39 years	100.0	2.3	29.9	—	67.8	33.3	34.5
40 - 44 years	100.0	--	20.8	4.2	75.0	20.8	54.2
45 - 49 years	(4/)	(4/)	(4/)	(4/)	(4/)	(4/)	(4/)
50 - 54 years	(4/)	(4/)	(4/)	(4/)	(4/)	(4/)	(4/)
55 - 59 years	—	—	—	—	—	—	—
60 - 64 years	—	--	—	—	—	—	—
65 years and over ...	—	--	—	—	—	—	--

1/ Such as Retired, and Fleet Reserve.
2/ Excludes 41 who did not report military status.
3/ Too few to compute median age.
4/ Too few to compute percentages.

Table A-9.--Distribution of chemists, by field of highest competence and level of education, 1951

Field of highest competence	Total	Ph.D.	Master's degree	Bachelor's degree	Some college
	Number				
Total	1/ 50,855	12,007	8,497	27,661	2,573
General chemistry	2,604	178	769	1,563	93
Analytical chemistry	6,732	804	1,087	4,384	451
Agricultural and food chemistry	3,081	583	485	1,786	224
Biochemistry	2,816	1,442	430	805	58
Inorganic chemistry	4,581	836	724	2,690	331
Organic chemistry	23,486	5,399	3,793	13,121	1,165
Pharmaceutical chemistry	2,214	616	345	1,151	87
Physical chemistry	4,106	2,045	681	1,300	77
Other chemistry specialties 2/	1,235	104	183	861	87
	Percent				
Total	3/ 100.0	23.6	16.7	54.4	5.1
General chemistry	100.0	6.8	29.6	60.0	3.6
Analytical chemistry	100.0	11.9	16.2	65.1	6.7
Agricultural and food chemistry	100.0	18.9	15.7	58.0	7.3
Biochemistry	100.0	51.2	15.2	28.6	2.1
Inorganic chemistry	100.0	18.2	15.8	58.7	7.3
Organic chemistry	100.0	23.0	16.2	55.8	5.0
Pharmaceutical chemistry	100.0	27.8	15.6	52.0	3.9
Physical chemistry	100.0	49.8	16.5	31.7	1.9
Other chemistry specialties 2/	100.0	8.4	14.8	69.7	7.1

1/ Excludes 422 chemists not reporting level of education. Table does not add to totals in the first column of figures because these include 117 chemists (81 of whom reported their highest field of competence as biochemistry) holding doctor's degrees other than the Ph.D., such as M.D., D.V.M., and D.D.S.

2/ Includes water, sewage, and sanitation chemistry; chemical warfare agents; industrial wastes; and food processing (such as concentration, drying, and refrigeration).

3/ Percentages in table do not always add to 100 because totals include chemists holding doctor's degrees other than the Ph.D.

Table A-10.—Age of chemists, by level of education and sex, 1951

Age group	Percent					
	All levels of education	Ph.D.	Other doctor's degree	Master's degree	Bachelor's degree	Some college
	Men and women					
Under 25 years	6.2	0.2	—	2.3	10.1	4.9
25 - 29 years	20.5	8.8	9.4	20.5	26.2	13.9
30 - 34 years	23.5	24.3	17.9	25.0	23.4	17.1
35 - 39 years	17.5	20.6	14.5	17.2	16.3	18.0
40 - 44 years	11.6	15.1	9.4	12.3	9.5	14.5
45 - 49 years	7.9	11.9	10.3	8.5	5.6	11.9
50 - 54 years	5.5	8.8	16.2	5.8	3.8	7.5
55 - 59 years	3.9	5.5	7.7	4.2	2.9	6.3
60 - 64 years	2.2	2.8	6.9	2.8	1.5	4.2
65 years and over	1.2	2.0	7.7	1.4	.7	1.7
Total	100.0	100.0	100.0	100.0	100.0	100.0
Median age	34	39	44	36	33	39
Total number reporting	1/ 50,840	12,003	117	8,494	27,657	2,569
	Men					
Under 25 years	4.9	0.2	—	1.9	8.0	4.7
25 - 29 years	19.3	8.7	9.1	19.1	24.8	12.9
30 - 34 years	24.3	24.6	18.0	25.8	24.5	17.2
35 - 39 years	18.3	21.0	14.4	18.0	17.3	18.2
40 - 44 years	12.0	15.2	9.9	12.7	10.0	14.8
45 - 49 years	8.1	11.7	9.9	8.4	5.9	12.1
50 - 54 years	5.6	8.5	17.1	5.8	4.0	7.5
55 - 59 years	3.9	5.3	6.3	4.0	3.1	6.4
60 - 64 years	2.3	2.8	7.2	2.8	1.6	4.4
65 years and over	1.3	2.0	8.1	1.5	.8	1.8
Total	100.0	100.0	100.0	100.0	100.0	100.0
Median age	35	39	44	36	34	39
Total number reporting	1/ 46,986	11,467	111	7,687	25,239	2,482
	Women					
Under 25 years	21.5	0.6	—	6.8	31.4	12.6
25 - 29 years	35.2	11.4	—	33.7	40.7	42.5
30 - 34 years	13.5	15.1	—	16.7	12.0	12.6
35 - 39 years	8.1	12.5	—	10.3	6.3	13.8
40 - 44 years	6.4	14.2	—	8.4	4.1	4.6
45 - 49 years	5.4	15.5	—	9.1	2.1	3.5
50 - 54 years	4.7	15.3	—	6.2	1.7	8.1
55 - 59 years	3.5	9.3	—	5.6	1.4	2.3
60 - 64 years	1.1	4.1	—	2.1	.2	—
65 years and over	.6	2.0	—	1.1	.1	—
Total	100.0	100.0	(2/)	100.0	100.0	100.0
Median age	29	44	—	33	27	29
Total number reporting	1/ 3,854	536	6	807	2,418	87

1/ Excludes 422 scientists (408 men and 14 women) not reporting level of education, and 15 (14 men and 1 woman) not reporting age.

2/ Number too small to compute percentages and median age.

Table A-11.--Fields of education of chemists, by level of education, 1951

Major subject for highest degree	All levels of education		Percent of chemists with--			
	Number	Percent	Ph.D.	Master's degree	Bachelor's degree	Some college
Physical sciences	39,561	78.4	94.4	77.5	72.1	76.1
Chemistry (including biochemistry)	38,921	77.2	93.3	75.7	70.9	73.9
Mathematics	128	.2	.1	.3	.3	.6
Metallurgy	90	.2	.1	.3	.2	.7
Physics, geophysics, and crystallography	155	.3	.3	.5	.2	.5
All others	267	.5	.6	.7	.5	.4
Agricultural sciences	279	.6	.9	.6	.4	.4
Agronomy and soil science	68	.1	.4	.1	.1	(1/)
Forestry	94	.2	.1	.2	.2	.1
All others	117	.3	.4	.3	.1	.3
Biological sciences	611	1.2	.9	1.0	1.4	.6
Biological science (general)	352	.7	.1	.5	1.1	.3
Botany	65	.1	.3	.1	(1/)	(1/)
Zoology	92	.2	.1	.2	.2	.1
All others	102	.2	.4	.2	.1	.1
Medical sciences	571	1.1	.7	1.1	1.0	1.4
Pharmacy	250	.5	.2	.3	.7	.8
Bacteriology	179	.4	.4	.7	.2	.2
Medicine and surgery	74	.1	(1/)	--	(1/)	.1
All others	68	.1	.1	.1	.1	.3
Engineering and architecture	8,170	16.2	2.4	12.4	23.3	18.7
Chemical and ceramic	6,690	13.3	2.1	9.9	19.3	13.8
All others	1,480	2.9	.3	2.5	4.0	4.9
Social sciences	975	1.9	.6	6.9	1.1	.8
Business administration	122	.2	--	1.1	.1	.3
Education	550	1.1	.2	4.8	.4	.1
Home economics	109	.2	.3	.3	.2	(1/)
All others	194	.4	.1	.7	.4	.4
Arts and sciences	279	.6	.1	.5	.7	2.0
Total	.....	100.0	100.0	100.0	100.0	100.0
Total number reporting	2/50,446	.....	12,009	8,626	27,326	2,356

1/ Less than 0.05 percent.

2/ Excludes 409 chemists not reporting field of education; 28 not reporting level of education; and 394 reporting neither. The total in column 1 includes 119 chemists holding doctor's degrees other than the Ph.D. (such as M.D., D.V.M., and D.D.S.), and 10 who had not taken any college courses.

Table A-12.--Comparison of chemists' fields of highest competence and fields of current employment, 1951

Field of current employment	Field of highest competence									
	All fields	General chemistry	Analytical chemistry	Agricultural and food chemistry	Inorganic chemistry	Organic chemistry	Pharmaceutical chemistry	Physical chemistry	Biochemistry	Other chemistry specialties
	Number									
Chemistry	47,385	1,775	6,383	2,916	4,252	22,259	2,107	3,868	2,668	1,157
General	3,639	1,480	413	85	448	729	37	301	111	35
Analytical	5,889	70	4,980	96	186	350	48	83	44	32
Agricultural and food	2,931	23	118	2,449	32	180	14	15	70	30
Inorganic	3,789	33	185	28	3,173	227	13	111	9	10
Organic	21,438	109	349	109	265	20,147	130	237	54	38
Pharmaceutical	2,256	10	97	29	22	216	1,811	12	56	3
Physical	3,534	18	117	9	102	190	4	3,058	17	19
Biochemistry	2,704	20	65	84	10	143	46	32	2,300	4
Other	1,205	12	59	27	14	77	4	19	7	986
Engineering	867	19	52	42	152	466	28	78	4	26
Chemical	723	11	44	39	116	404	27	64	3	15
All other	144	8	8	3	36	62	1	14	1	11
Biological sciences	39	1	3	7	—	1	6	1	18	2
Physics	59	8	10	1	6	2	—	30	—	2
Metallurgy	80	5	16	2	40	10	—	5	—	2
Complex systems analysis	78	40	5	—	6	16	1	5	4	1
All other scientific fields	61	7	9	4	16	11	3	8	3	—
Nonscientific fields	1,386	437	153	80	112	445	44	43	51	21
Total number reporting	49,955 1/	2,292	6,631	3,052	4,584	23,210	2,189	4,038	2,748	1,211

See footnotes at end of table.

Table A-12.--Comparison of chemists' fields of highest competence and fields of current employment, 1951--(Continued)

Field of current employment	Field of highest competence									
	All fields	General chemistry	Analytical chemistry	Agricultural and food chemistry	Inorganic chemistry	Organic chemistry	Pharmaceutical chemistry	Physical chemistry	Biochemistry	Other chemistry specialties
	Percent									
Chemistry	94.9	77.5	96.3	95.6	92.8	95.9	96.3	95.9	97.1	95.5
General	7.3	64.6	6.2	2.8	9.8	3.2	1.7	7.5	4.0	2.9
Analytical	11.8	3.1	75.0	3.1	4.1	1.5	2.2	2.1	1.6	2.6
Agricultural and food	5.9	1.0	1.8	80.2	.7	.8	.6	.4	2.6	2.5
Inorganic	7.6	1.4	2.8	.9	69.2	1.0	.6	2.7	.3	.8
Organic	42.9	4.8	5.3	3.6	5.8	86.8	6.0	5.9	2.0	3.1
Pharmaceutical	4.5	.4	1.5	1.0	.5	.9	82.7	.3	2.0	.3
Physical	7.1	.8	1.8	.3	2.2	.8	.2	75.7	.6	1.6
Biochemistry	5.4	.9	1.0	2.8	.2	.6	2.1	.8	83.7	.3
Other	2.4	.5	.9	.9	.3	.3	.2	.5	.3	81.4
Engineering	1.7	.8	.8	1.4	3.3	2.0	1.3	1.9	.1	2.1
Chemical	1.4	.5	.7	1.3	2.5	1.7	1.3	1.6	.1	1.2
All other	.3	.3	.1	.1	.8	.3	(2/)	.3	(2/)	.9
Biological sciences	.1	(2/)	(2/)	.2	—	(2/)	.3	(2/)	.7	.2
Physics	.1	.3	.2	(2/)	.1	(2/)	—	.7	—	.2
Metallurgy	.2	.2	.2	.1	.9	(2/)	—	.1	—	.2
Complex systems analysis	.2	1.8	.1	—	.1	.1	(2/)	.1	.1	.1
All other scientific fields	.1	.3	.1	.1	.3	.1	.1	.2	.1	—
Nonscientific fields	2.7	19.1	2.3	2.6	2.5	1.9	2.0	1.1	1.9	1.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

1/ Excludes 122 unemployed; 616 on active duty with Armed Forces in nonscientific capacity, and 584 not reporting field of current employment.

2/ Less than 0.05 percent.

Table A-13.--Industries in which chemists were employed, 1951

Industry	Total	Men	Women
All industries	1/47,270	1/43,846	1/3,424
Metal mining	67	64	3
Anthracite, bituminous coal, and lignite mining	30	24	6
Crude petroleum and natural gas extraction	134	131	3
Mining and quarrying of nonmetallic minerals	54	52	2
Construction	14	14	--
Ordnance and accessories	70	67	3
Food and kindred products	2,373	2,207	166
Tobacco	63	57	6
Textile mill products	682	646	36
Apparel	19	18	1
Lumber and wood products	39	38	1
Furniture and fixtures	13	13	--
Paper and allied products	1,001	979	22
Printing, publishing, and allied products	83	71	12
Chemical and allied products	17,596	16,632	964
Industrial chemicals	9,393	8,918	475
Drugs and medicine	2,952	2,662	290
Soaps and glycerin, sulfonated oils	867	828	39
Paints, lacquers, varnishes, wood fillers, etc.	1,573	1,542	31
Gum and wood chemicals	53	53	--
Fertilizers	167	161	6
Vegetable and animal oils, and fats	198	189	9
All other	2,393	2,279	114
Products of petroleum and coal	3,717	3,559	158
Petroleum refining	3,262	3,121	141
Coke and byproducts	61	60	1
Paving and roofing materials	101	97	4
All other	293	281	12
Rubber products	1,434	1,401	33
Leather and leather products	119	118	1
Stone, clay, and glass products	756	737	19
Primary metals products	865	837	28
Fabricated metal products	321	307	14
Machinery (except electrical)	470	441	29
Electrical machinery	814	779	35
Transportation equipment	402	374	28
Motor vehicles and equipment	185	174	11
Aircraft and parts	171	155	16
All other	46	45	1
Professional, controlling, and scientific instruments	886	842	44
Photographic equipment and supplies	293	276	17
All other	593	566	27
Miscellaneous manufacturing industries	1,324	1,239	85

See footnotes at end of table.

Table A-13.--Industries in which chemists were employed, 1951
(Continued)

Industry	Total	Men	Women
Railroads, railways, bus lines, taxicabs, water transportation	104	104	--
Pipeline transportation	10	9	1
Telecommunications	42	37	5
Utilities and sanitary services	144	143	1
Wholesale trade	229	224	5
Retail trade, holding and other investments, and personal service	52	47	5
Miscellaneous business services 2/	1,195	1,089	106
Motion pictures	19	18	1
Medical and other health services	343	211	132
Hospitals	289	174	115
All other	54	37	17
Legal services	18	17	1
Educational services	6,686	5,739	947
Colleges, universities, professional schools, junior colleges, and normal schools	5,855	5,068	787
Elementary and secondary schools	823	663	160
All other	8	8	--
Nonprofit membership organizations	159	136	23
Miscellaneous services	1,097	936	161
Engineering and architectural services	199	191	8
Nonprofit educational and scientific research agencies	894	742	152
All other	4	3	1
Federal Government	2,986	2,737	249
State government	519	467	52
Local government	308	274	34
All other	13	11	2

1/ Excludes 115 not reporting industry (111 men and 4 women).
2/ Includes commercially operated research agencies and testing laboratories.

Table A-14.--Industries in which chemists were employed, by level of education, 1951

Industries	All levels of education	Ph.D.	Master's degree	Bachelor's degree	Some college
	Percent				
Manufacturing	66.6	49.2	59.3	75.4	81.6
Chemicals and allied products	37.2	31.3	34.3	40.3	42.7
Industrial chemicals	19.9	18.2	17.7	21.4	19.5
Drugs and medicine	6.3	6.7	6.2	6.2	4.8
Soaps and glycerin	1.8	1.1	1.6	2.1	2.6
Paints and varnishes	3.3	1.2	3.0	4.1	7.0
All other chemicals	5.9	4.1	5.8	6.5	8.8
Petroleum and coal products	7.9	5.9	8.0	9.0	5.9
Petroleum refining	7.0	5.4	7.1	7.8	4.9
All other petroleum and coal products	.9	.5	.9	1.2	1.0
Food and kindred products	5.0	2.7	4.5	5.9	8.0
Paper and allied products	2.1	1.0	1.5	2.9	1.6
Rubber products	3.0	1.6	2.2	3.9	3.8
Primary metals	1.8	.6	1.1	2.2	5.7
Electrical machinery	1.7	1.4	1.5	1.9	1.8
Professional and scientific instruments	1.9	2.1	1.5	1.9	1.6
All other manufacturing	6.0	2.6	4.7	7.4	10.5
Research and consulting services	4.8	5.6	4.8	4.3	5.9
Educational institutions	14.1	32.5	20.8	4.8	1.0
Colleges and universities	12.3	32.2	16.0	3.1	.8
All other	1.8	.3	4.8	1.7	.2
Government	8.3	7.4	9.4	8.6	5.2
Other industries, not elsewhere classified	6.2	5.3	5.7	6.9	6.3
Total	100.0	100.0	100.0	100.0	100.0
Total number reporting	1/ 46,875	11,568	7,857	25,086	2,364

1/ Excludes 374 not reporting level of education, 107 whose highest degree was a doctor's degree other than the Ph.D. (such as M.D., D.D.S., and D.V.M.), and 29 not reporting industry.

Table A-15.--Distribution of chemists within each industry, by level of education, 1951

Industries	All levels of education		Percent of chemists with--			
	Number	Percent	Ph.D.	Master's degree	Bachelor's degree	Some college
All industries	1/46,875	100.0	24.7	16.8	53.5	5.0
Manufacturing	31,213	100.0	18.2	14.9	60.7	6.2
Chemicals and allied products	17,429	100.0	20.8	15.5	58.0	5.7
Industrial chemicals	9,307	100.0	22.5	14.9	57.6	5.0
Drugs and medicine	2,933	100.0	26.5	16.7	53.0	3.8
Soaps and glycerin	858	100.0	15.4	14.8	62.7	7.1
Paints and varnishes	1,550	100.0	8.6	15.0	65.7	10.7
All other chemicals	2,781	100.0	17.1	16.6	58.9	7.4
Petroleum and coal products	3,698	100.0	18.3	16.9	61.0	3.8
Petroleum refining	3,262	100.0	19.2	17.0	60.3	3.5
All other petroleum and coal products	436	100.0	12.2	16.3	66.0	5.5
Food and kindred products	2,351	100.0	13.7	14.9	63.4	8.0
Paper and allied products	996	100.0	11.6	11.9	72.8	3.7
Rubber products	1,422	100.0	13.1	12.4	68.1	6.4
Primary metals	834	100.0	7.7	10.4	65.8	16.1
Electrical machinery	811	100.0	19.7	14.7	60.3	5.3
Professional and scientific instruments	880	100.0	28.2	13.6	53.9	4.3
All other manufacturing	2,792	100.0	10.9	13.2	67.1	8.8
Research and consulting services	2,258	100.0	28.8	16.8	48.2	6.2
Educational institutions	6,613	100.0	56.8	24.7	18.1	.4
Colleges and universities	5,783	100.0	64.4	21.7	13.6	.3
All other	830	100.0	3.9	45.8	49.7	.6
Government	3,865	100.0	22.1	19.1	55.6	3.2
Other industries, not elsewhere classified	2,926	100.0	20.9	15.3	58.7	5.1

1/ Excludes 374 not reporting level of education, 107 whose highest degree was a doctor's degree other than the Ph.D. (such as M.D., D.D.S., and D.V.M.), and 29 not reporting industry.

Table A-16.--Distribution of chemists, by field of employment in each industry, 1951

Industry	All fields	General chemistry	Analytical chemistry	Agricultural and food chemistry	Inorganic chemistry	Organic chemistry	Pharmaceutical chemistry	Physical chemistry	Biochemistry	Other chemistry specialties
	Number									
Manufacturing	31,519	418	3,881	1,938	2,772	17,919	1,759	1,795	582	455
Chemicals and allied products.	17,596	216	2,026	573	1,555	10,216	1,696	709	405	200
Industrial chemicals	9,393	143	1,141	191	977	6,193	118	488	47	95
Drugs and medicine	2,952	21	450	85	27	625	1,378	41	312	13
Soaps and glycerin	867	7	82	11	30	652	22	37	12	14
Paints and varnishes	1,573	8	55	6	188	1,272	2	33	4	5
All other chemicals	2,811	37	298	280	333	1,474	176	110	30	73
Petroleum and coal products	3,717	31	397	26	57	2,949	4	209	9	35
Petroleum refining	3,278	25	374	19	47	2,570	3	199	7	34
All other petroleum and coal products	439	6	23	7	10	379	1	10	2	1
Food and kindred products	2,373	32	240	1,270	17	557	22	28	138	69
Paper and allied products	1,001	10	40	5	23	883	2	20	3	15
Rubber products	1,434	11	68	7	15	1,299	2	28	1	3
Primary metals	865	13	349	1	331	101	2	62	1	5
Electrical machinery	814	23	158	5	126	279	4	208	2	9
Professional and scientific instruments	886	23	187	3	51	307	15	276	8	16
All other manufacturing	2,833	59	416	48	597	1,328	12	255	15	103
Research and consulting services	2,292	50	380	169	163	855	62	235	252	126
Educational institutions	6,686	1,135	806	232	595	1,635	172	1,006	1,061	44
Colleges and universities	5,855	424	778	228	568	1,597	171	994	1,054	41
All other	831	711	28	4	27	38	1	12	7	3
Government	3,898	76	765	457	209	1,085	68	385	430	423
Other industries	2,961	96	548	121	510	754	45	443	337	107
Total reporting	1/ 47,356	1,775	6,380	2,917	4,249	22,248	2,106	3,864	2,662	1,155

See footnote at end of table.

Table A-16.--Distribution of chemists, by field of employment in each industry, 1951 (continued)

Industry	All fields	General chemistry	Analytical chemistry	Agricultural and food chemistry	Inorganic chemistry	Organic chemistry	Pharmaceutical chemistry	Physical chemistry	Biochemistry	Other chemistry specialties
	Percent									
Manufacturing	100.0	1.3	12.3	6.2	8.8	56.8	5.6	5.7	1.8	1.5
Chemicals and allied products	100.0	1.2	11.5	3.3	8.8	58.1	9.7	4.0	2.3	1.1
Industrial chemicals	100.0	1.5	12.2	2.0	10.4	65.9	1.3	5.2	.5	1.0
Drugs and medicine	100.0	.7	15.2	2.9	.9	21.2	46.7	1.4	10.6	.4
Soaps and glycerin	100.0	.8	9.4	1.3	3.5	75.2	2.5	4.3	1.4	1.6
Paints and varnishes	100.0	.5	3.5	.4	12.0	80.9	.1	2.1	.2	.3
All other chemicals	100.0	1.3	10.6	10.0	11.8	52.4	6.3	3.9	1.1	2.6
Petroleum and coal products	100.0	.8	10.7	.7	1.5	79.3	.1	5.6	.3	1.0
Petroleum refining	100.0	.8	11.4	.6	1.4	78.4	.1	6.1	.2	1.0
All other petroleum and coal products	100.0	1.4	5.2	1.6	2.3	86.3	.2	2.3	.5	.2
Food and kindred products	100.0	1.4	10.1	53.5	.7	23.5	.9	1.2	5.8	2.9
Paper and allied products	100.0	1.0	4.0	.5	2.3	88.2	.2	2.0	.3	1.5
Rubber products	100.0	.8	4.7	.5	1.0	90.6	.1	2.0	.1	.2
Primary metals	100.0	1.5	40.3	.1	38.3	11.7	.2	7.2	.1	.6
Electrical machinery	100.0	2.8	19.4	.6	15.5	34.3	.5	25.6	.2	1.1
Professional and scientific instruments	100.0	2.6	21.1	.3	5.8	34.6	1.7	31.2	.9	1.8
All other manufacturing	100.0	2.1	14.7	1.7	21.1	46.9	.4	9.0	.5	3.6
Research and consulting services	100.0	2.2	16.6	7.4	7.1	37.3	2.7	10.2	11.0	5.5
Educational institutions	100.0	17.0	12.0	3.5	8.9	24.4	2.6	15.0	15.9	.7
Colleges and universities	100.0	7.2	13.3	3.9	9.7	27.3	2.9	17.0	18.0	.7
All other	100.0	85.6	3.4	.5	3.2	4.6	.1	1.4	.8	.4
Government	100.0	2.0	19.6	11.7	5.4	27.8	1.7	9.9	11.0	10.9
Other industries	100.0	3.2	18.5	4.1	17.2	25.5	1.5	15.0	11.4	3.6
Total	100.0	3.7	13.5	6.2	9.0	47.0	4.4	8.2	5.6	2.4

1/ Excludes 29 chemists who did not report industry.

Table A-17.--Level of education of women chemists, by industry, 1951

Industries	All levels of education	Ph.D.	Master's degree	Bachelor's degree	Some college
Manufacturing	46.4	18.9	30.0	57.8	53.7
Chemicals and allied products	28.2	13.3	18.1	35.0	23.8
Industrial chemicals	15.3	7.5	9.8	19.3	6.3
Drugs and medicine	8.5	4.2	6.8	10.0	7.5
Soaps and glycerin	1.2	.8	.4	1.5	1.2
Paints and varnishes	.9	—	—	1.3	2.5
All other chemicals	2.3	.8	1.1	2.9	6.3
Petroleum and coal products	4.6	1.0	4.5	5.3	8.8
Petroleum refining	4.2	1.0	4.1	4.8	6.3
All other petroleum and coal products	.4	—	.4	.5	2.5
Food and kindred products	4.9	1.7	2.9	6.1	10.0
Paper and allied products	.6	—	.4	.8	—
Rubber products	1.0	.4	.1	1.4	1.2
Primary metals	.8	—	.1	1.1	2.5
Electrical machinery	1.0	.4	.6	1.3	1.2
Professional and scientific instruments	1.3	.8	.6	1.6	1.2
All other manufacturing	4.0	1.3	2.7	5.2	5.0
Research and consulting services	7.8	8.1	6.0	8.0	15.0
Educational institutions	27.6	57.9	44.0	16.0	7.5
Colleges and universities	22.9	57.3	36.5	11.3	5.0
All other	4.7	.6	7.5	4.7	2.5
Government	9.8	11.0	11.6	9.0	8.8
Other industries, n.e.c.	8.4	4.1	8.4	9.2	15.0
Total	100.0	100.0	100.0	100.0	100.0
Total number reporting	1/ 3,408	482	716	2,130	80

1/ Excludes 6 women chemists reporting "other doctor's degrees", 12 not reporting level of education, and 2 not reporting industry.

Table A-18.--Functions performed by chemists in each industry, 1951

Industry	All functions		Percent of chemists in--									
	Number	Percent	Research and development	Consulting	Management	Teaching	Technical writing	Design	Analysis and testing	Production	Technical sales and services	Other
All industries	1/47,274	100.0	45.1	1.6	11.1	11.1	1.8	0.4	18.3	6.2	4.2	0.2
Manufacturing	31,462	100.0	49.3	1.0	13.4	.1	1.9	.4	19.5	8.4	5.7	.3
Chemicals and allied products	17,573	100.0	50.4	.8	13.9	.1	2.0	.3	15.5	9.4	7.4	.2
Industrial chemicals	9,378	100.0	49.7	.9	13.4	.1	2.2	.3	14.3	9.7	9.1	.3
Drugs and medicine	2,950	100.0	51.0	.7	13.6	.1	1.8	.2	19.8	10.5	2.2	.1
Soaps and glycerin	863	100.0	47.9	.8	16.1	.1	.9	.3	19.5	8.4	6.0	--
Paints and varnishes	1,572	100.0	58.2	.3	14.1	.1	.6	.1	11.4	8.8	6.0	.4
All other chemicals	2,810	100.0	48.6	.8	15.2	--	2.5	.1	15.9	8.4	8.4	.1
Petroleum and coal products	3,709	100.0	49.7	1.6	12.2	.1	3.3	.8	21.3	6.6	4.3	.1
Petroleum refining	3,271	100.0	50.3	1.7	12.3	.1	3.7	.9	20.9	6.2	3.8	.1
All other petroleum and coal products	438	100.0	44.7	.9	11.2	--	.9	.7	24.2	9.4	8.0	--
Food and kindred products	2,372	100.0	39.0	.8	15.3	(2/)	.8	.2	32.6	7.8	3.2	.3
Paper and allied products	996	100.0	50.3	.5	11.9	--	.5	.8	20.1	12.9	2.6	.4
Rubber products	1,432	100.0	57.8	.6	13.9	.1	1.5	.5	15.2	7.0	3.1	.3
Primary metals	862	100.0	29.5	1.0	13.7	.1	.8	--	46.3	6.2	2.1	.3
Electrical machinery	812	100.0	61.8	1.7	9.2	--	.4	.3	21.2	3.1	1.7	.6
Professional and scientific instruments	883	100.0	56.5	.6	12.2	.3	2.3	1.2	13.2	6.2	7.0	.5
All other manufacturing	2,823	100.0	47.0	1.4	12.4	(2/)	1.7	.7	26.3	6.7	3.3	.5
Research and consulting services	2,290	100.0	53.0	15.0	10.2	.2	2.0	.4	17.4	.7	1.1	--
Educational institutions	6,683	100.0	18.2	.1	1.7	76.9	.5	(2/)	2.2	.2	.1	.1
Colleges and universities	5,853	100.0	20.8	(2/)	1.8	74.1	.5	(2/)	2.4	.2	.1	.1
All other	830	100.0	.1	.2	1.1	97.0	.9	--	.6	--	--	.1
Government	3,892	100.0	50.9	1.6	9.2	1.5	1.5	.3	32.1	2.6	.1	.2
Other industries, n.e.c.	2,947	100.0	46.7	1.7	10.7	.5	3.2	.6	24.5	6.0	5.7	.4

1/ Excludes 111 chemists who did not report industry or function.
2/ Less than 0.05 percent.

Table A-19.--Function performed by chemists, by level of education and age group, 1951

Age group	All functions		Research and development	Consulting	Management	Teaching	Technical writing	Design	Analysis and testing	Production	Technical sales and services
	Number	Percent									
	Ph.D.										
All ages	1/11,559	100.0	55.3	1.7	11.6	25.9	1.4	0.2	1.8	1.0	1.1
Under 25 years	28	100.0	78.5	3.6	3.6	10.7	3.6	--	--	--	--
25 - 29 years	1,030	100.0	73.0	.3	.5	24.3	.3	.1	1.0	0.3	0.2
30 - 34 years	2,853	100.0	70.6	.6	3.1	22.0	1.0	.3	.9	.6	.8
35 - 39 years	2,400	100.0	61.6	1.2	10.4	21.1	1.3	.1	1.9	.7	1.7
40 - 44 years	1,740	100.0	50.1	1.2	17.6	23.7	1.6	.1	2.5	1.7	1.5
45 - 49 years	1,365	100.0	43.5	2.8	19.9	26.5	2.3	.1	2.3	1.4	1.2
50 - 54 years	1,002	100.0	33.7	2.4	21.2	35.6	2.0	.3	2.8	1.3	.6
55 - 59 years	615	100.0	30.1	4.6	18.5	41.3	1.6	--	1.6	2.0	.3
60 - 64 years	312	100.0	26.9	5.8	16.7	43.0	1.9	.6	1.9	1.0	2.2
65 years and over	214	100.0	24.8	9.8	16.8	42.1	3.3	--	1.4	1.4	.4
	Master's degree										
All ages	1/7,847	100.0	49.2	1.4	9.8	17.9	2.0	0.5	11.1	4.5	3.5
Under 25 years	166	100.0	62.1	0.6	1.2	19.3	1.8	.6	8.4	1.2	3.0
25 - 29 years	1,602	100.0	63.9	.7	1.4	14.3	1.3	.6	11.9	2.6	3.0
30 - 34 years	1,978	100.0	58.5	1.0	6.0	10.7	1.5	.6	12.2	5.0	4.3
35 - 39 years	1,379	100.0	52.0	1.2	11.4	11.5	2.1	.4	10.9	6.4	4.1
40 - 44 years	967	100.0	39.6	1.3	15.8	21.0	2.1	.7	10.3	5.4	3.8
45 - 49 years	661	100.0	30.1	1.5	16.0	29.1	2.4	.2	12.7	5.1	2.9
50 - 54 years	444	100.0	27.2	2.5	18.5	30.9	3.8	--	9.2	5.2	2.7
55 - 59 years	329	100.0	25.2	2.7	22.2	34.4	2.7	--	7.9	3.1	1.8
60 - 64 years	219	100.0	26.0	4.1	19.2	37.4	2.7	.5	7.8	1.4	.9
65 years and over	102	100.0	15.7	8.8	14.7	42.2	3.9	--	10.8	3.9	--

See footnote at end of table

Table A-19.--Function performed by chemists, by level of education and age group, 1951
(Continued)

Age group	All functions		Research and development	Consulting	Management	Teaching	Technical writing	Design	Analysis and testing	Production	Technical sales and services
	Number	Percent									
	Bachelor's degree										
All ages	1/25,044	100.0	40.6	1.6	10.8	3.1	1.9	0.5	26.4	8.8	5.9
Under 25 years ...	2,163	100.0	38.8	.7	1.0	4.2	3.2	.3	40.9	6.1	3.7
25 - 29 years ...	6,603	100.0	43.6	.8	2.1	3.2	2.2	.5	33.5	7.9	5.3
30 - 34 years ...	5,994	100.0	46.2	1.2	7.4	2.1	1.6	.6	23.8	9.4	7.6
35 - 39 years ...	4,206	100.0	42.0	1.8	15.2	2.6	1.6	.5	19.3	10.4	6.5
40 - 44 years ...	2,434	100.0	36.5	2.0	19.3	3.8	1.7	.5	20.8	9.8	5.6
45 - 49 years ...	1,414	100.0	31.4	1.7	22.7	3.6	1.7	.4	22.9	9.9	5.7
50 - 54 years ...	947	100.0	28.3	3.3	29.4	4.3	2.3	.1	20.5	6.5	5.3
55 - 59 years ...	738	100.0	25.9	3.7	31.6	4.1	2.2	.1	18.7	8.7	5.0
60 - 64 years ...	364	100.0	21.1	6.9	29.7	5.5	.8	--	22.0	10.4	3.6
65 years and over	181	100.0	20.5	9.9	30.4	5.5	1.1	--	23.2	5.5	3.9
	Incomplete college										
All ages	1/2,355	100.0	32.6	2.1	14.8	0.3	0.8	0.2	35.3	9.5	4.3
Under 25 years ...	95	100.0	34.7	1.1	1.1	1.1	--	--	57.8	3.1	--
25 - 29 years ...	320	100.0	32.2	1.3	3.1	--	1.3	--	51.9	8.1	1.8
30 - 34 years ...	413	100.0	42.6	1.9	5.6	--	.5	.5	37.0	7.3	4.6
35 - 39 years ...	445	100.0	38.2	1.4	13.7	--	1.1	--	30.1	10.3	5.2
40 - 44 years ...	346	100.0	30.6	1.2	17.6	.3	.3	.3	32.9	11.3	5.5
45 - 49 years ...	276	100.0	29.0	3.3	22.5	.4	1.4	.4	28.2	9.4	5.4
50 - 54 years ...	176	100.0	25.0	5.1	26.1	.6	.6	--	29.0	9.1	4.5
55 - 59 years ...	148	100.0	18.9	1.4	29.1	.7	--	.7	31.0	13.5	4.7
60 - 64 years ...	97	100.0	23.7	4.2	30.9	1.0	--	--	26.8	10.3	3.1
65 years and over	39	100.0	12.8	5.1	33.3	--	2.6	--	20.5	18.0	5.1

1/ Includes 4 chemists holding Ph.D.'s, 11 master's degrees, 99 bachelor's degrees, and 3 with no college degree reporting functions other than those shown here; excludes 7 chemists with Ph.D.'s, 11 with master's degrees, 59 with bachelors, and 6 with no college degree not reporting function; 4 Ph.D.'s, 3 master's degrees, 4 bachelor's degrees, and 3 with no college degree not reporting age; and 1 chemist with no college degree reporting neither.

Table A-20.--Age of chemists, by function performed, 1951

Age group	All functions	Research and development	Consulting	Management	Teaching	Technical writing	Design	Analysis and testing	Production	Technical sales and services
	Percent									
Under 25 years ...	5.2	4.7	2.4	0.5	2.4	8.7	4.6	11.1	4.7	4.3
25 - 29 years ...	20.2	22.4	9.8	3.4	13.2	20.8	23.7	29.9	20.2	20.5
30 - 34 years ...	23.9	28.8	15.3	12.9	18.5	19.2	31.8	21.6	24.3	29.4
35 - 39 years ...	18.0	19.5	17.0	21.2	15.1	15.8	16.8	13.4	20.1	19.8
40 - 44 years ...	11.8	10.6	11.6	19.1	13.6	11.0	12.7	9.1	12.5	11.1
45 - 49 years ...	8.0	6.3	10.7	14.7	11.7	9.2	5.2	6.1	7.7	6.6
50 - 54 years ...	5.6	3.7	10.1	12.2	10.4	7.3	2.3	3.8	4.1	3.8
55 - 59 years ...	3.9	2.3	8.8	9.0	7.7	4.5	1.2	2.6	3.7	2.7
60 - 64 years ...	2.2	1.2	7.6	4.6	4.6	1.8	1.7	1.6	1.9	1.3
65 years and over	1.2	.5	6.7	2.4	2.8	1.7	--	.8	.8	.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total number reporting.....	1/47,231	21,309	759	5,238	5,241	825	173	8,635	2,944	1,990
Median age	35	34	42	43	40	35	33	32	35	34

1/ Excludes 67 not reporting age and 87 not reporting function; includes 117 reporting a function other than those listed above.

Table A-21.--Function performed by women chemists, by level of education, 1951

Function	All levels of education	Ph.D.	Master's degree	Bachelor's degree	Some college
Research and development	37.0	46.5	38.9	34.3	34.1
Consulting	.6	.4	.6	.7	—
Management	1.2	1.5	1.7	1.0	1.3
Teaching	18.7	42.3	35.5	8.2	1.3
Technical writing	9.9	5.8	8.3	11.4	8.9
Design	(1/)	—	—	(1/)	—
Analysis and testing	30.7	2.7	13.6	42.1	53.1
Production	1.2	.4	.7	1.5	1.3
Technical sales and services	.6	.2	.7	.7	—
Other	.1	.2	—	.1	—
Total	100.0	100.0	100.0	100.0	100.0
Total number reporting	2/ 3,395	482	714	2,120	79

1/ Less than 0.05 percent.

2/ Excludes 15 women chemists not reporting function and 12 not reporting level of education; includes 6 with doctor's degrees other than the Ph.D. (such as M.D., D.D.S.,and D.V.M.).

Table A-22.--Age of women chemists, by function performed, 1951

Age group	All functions	Research and development	Consulting	Management	Teaching	Technical writing	Design	Analysis and testing	Production	Technical sales and services	Other
Under 25 years	20.5	20.5	20.0	4.9	8.5	20.2	--	28.1	30.8	19.0	(1/)
25 - 29 years	35.3	42.2	20.0	17.0	16.7	35.4	--	39.5	33.3	23.9	--
30 - 34 years	13.7	15.5	25.0	19.5	9.4	14.0	--	13.8	7.7	19.0	--
35 - 39 years	8.4	8.2	15.0	9.8	9.6	10.7	--	6.7	12.8	19.0	(1/)
40 - 44 years	6.5	4.8	--	19.5	12.4	6.5	(1/)	4.3	10.3	4.8	--
45 - 49 years	5.7	3.6	--	12.2	14.3	4.8	--	3.5	--	4.8	--
50 - 54 years	4.6	3.3	10.0	9.8	12.0	4.8	--	1.6	--	--	(1/)
55 - 59 years	3.6	1.4	10.0	7.3	9.9	3.3	--	2.0	5.1	9.5	--
60 - 64 years	1.2	.3	--	--	5.2	--	--	.3	--	--	--
65 years and over ..	.5	.2	--	--	2.0	.3	--	.2	--	--	--
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total number reporting	2/3,411	1,261	20	41	636	336	1/ 1	1,052	39	21	1/ 4
Median age	29	29	32	39	42	29	(3/)	28	28	32	(3/)

1/ Too few to compute percentages.
2/ Excludes 2 chemists not reporting age and 15 chemists not reporting function.
3/ Too few to compute median age.

Table A-23.--Annual professional income of chemists, by age, 1951

Annual income	All age groups	Under 25 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65 years and over
$ 0 - $ 2,999	4.3	27.4	8.1	1.8	1.1	1.3	1.2	1.4	2.0	2.2	3.5
$ 3,000 - $ 3,999	17.3	56.5	40.3	13.1	5.4	4.9	5.5	4.8	3.8	5.0	6.5
$ 4,000 - $ 4,999	19.6	13.9	32.3	24.8	14.2	11.9	11.0	10.4	9.4	11.2	12.1
$ 5,000 - $ 5,999	17.4	1.8	13.6	25.8	20.4	16.3	14.4	12.1	12.9	14.2	16.5
$ 6,000 - $ 6,999	13.1	.2	4.4	17.8	18.9	16.0	14.1	13.3	11.6	12.5	14.0
$ 7,000 - $ 7,999	8.8	.1	1.0	9.2	14.0	13.4	12.5	10.8	11.5	13.1	9.7
$ 8,000 - $ 9,999	8.6	--	.2	5.0	14.7	15.4	15.1	16.2	13.8	12.2	13.2
$10,000 - $14,999	7.0	.1	.1	2.1	8.9	14.3	16.5	16.7	18.5	13.7	12.1
$15,000 and over	3.9	--	(1/)	.4	2.4	6.5	9.7	14.3	16.5	15.9	12.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total number reporting	2/37,919	2,109	7,942	9,183	6,785	4,347	2,949	2,045	1,422	766	371
Median income	$5,500	$3,400	$4,100	$5,400	$6,500	$7,000	$7,300	$7,700	$7,900	$7,400	$6,800
Lower quartile income	4,200	2,700	3,400	4,400	5,200	5,400	5,500	5,700	5,800	5,500	5,200
Upper quartile income	7,400	3,800	4,800	6,500	8,100	9,400	10,400	11,800	12,700	11,700	9,900

1/ Less than 0.05 percent.
2/ Excludes 9,397 not reporting income, 42 not reporting age, and 27 not reporting income or age.

Table A-24.--Median and quartile incomes of chemists, by level of education and age, 1951

Age group	All levels of education	Ph.D.	Master's degree	Bachelor's degree	Some college
All ages:					
Median 1/	$5,500	$6,900	$5,400	$4,900	$5,000
Lower quartile	4,200	5,600	4,300	3,800	4,000
Upper quartile	7,400	9,200	6,900	6,600	7,000
Under 25 years:					
Median	3,400	5,200	3,600	3,400	3,200
Lower quartile	2,700	4,100	3,100	2,700	2,000
Upper quartile	3,800	5,900	4,300	3,800	3,700
25 - 29 years:					
Median	4,100	5,300	4,300	3,900	3,700
Lower quartile	3,400	4,400	3,600	3,400	3,200
Upper quartile	4,800	6,000	4,900	4,600	4,400
30 - 34 years:					
Median	5,400	6,200	5,300	5,100	4,600
Lower quartile	4,400	5,200	4,300	4,300	3,800
Upper quartile	6,500	7,200	6,400	6,100	5,600
35 - 39 years:					
Median	6,500	7,600	6,200	6,100	5,600
Lower quartile	5,200	6,200	5,000	5,000	4,500
Upper quartile	8,200	9,400	7,600	7,700	6,900
40 - 44 years:					
Median	7,000	8,300	6,500	6,700	5,900
Lower quartile	5,400	6,500	5,000	5,200	4,800
Upper quartile	9,500	11,300	8,500	8,900	7,500
45 - 49 years:					
Median	7,300	8,300	6,100	7,200	6,500
Lower quartile	5,500	6,400	4,600	5,500	4,900
Upper quartile	10,400	12,200	8,600	10,100	9,000
50 - 54 years:					
Median	7,800	8,300	6,300	8,000	7,100
Lower quartile	5,700	6,300	4,700	5,800	5,200
Upper quartile	11,800	12,300	9,300	12,600	10,100
55 - 59 years:					
Median	7,900	8,400	6,000	8,500	7,500
Lower quartile	5,800	6,200	4,800	6,200	5,500
Upper quartile	12,700	12,500	10,800	13,700	11,900
60 - 64 years:					
Median	7,400	7,700	6,000	7,500	7,600
Lower quartile	5,500	5,900	4,700	5,600	5,600
Upper quartile	11,700	12,400	8,800	12,400	13,100
65 years and over:					
Median	6,800	7,400	5,800	6,800	6,800
Lower quartile	5,200	5,600	4,500	5,000	4,900
Upper quartile	9,900	9,900	9,100	11,300	8,800

1/ All median and quartile figures have been rounded to nearest hundred.

Table A-25.--Median and quartile incomes of chemists, by age group, for the principal types of employers, 1951

Type of employer and annual income	All age groups	Under 25 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65 years and over
Colleges and universities:											
Median.....	$4,900	$2,100	$3,700	$4,700	$5,400	$5,700	$5,800	$6,100	$6,400	$6,100	$6,000
Lower quartile...	3,800	1,100	3,200	3,900	4,400	4,400	4,500	4,700	5,000	4,800	5,000
Upper quartile...	6,300	3,200	4,500	5,500	6,600	7,000	7,300	8,100	8,400	7,800	7,800
Government:											
Median.....	5,000	3,400	3,700	4,700	5,500	5,800	6,100	6,600	6,600	7,100	6,700
Lower quartile...	3,900	3,000	3,300	3,900	4,600	4,800	5,100	5,200	5,300	5,500	5,400
Upper quartile...	6,300	3,700	4,300	5,700	6,500	7,000	7,600	8,000	8,300	8,200	8,500
Private industry:1/											
Median.....	5,800	3,500	4,200	5,600	6,800	7,600	8,300	9,300	9,300	8,900	7,800
Lower quartile...	4,400	3,100	3,500	4,600	5,500	6,000	6,300	6,700	6,800	6,300	5,400
Upper quartile...	7,800	3,900	4,900	6,800	8,700	10,400	12,300	14,300	15,000+	15,000+	13,800

1/ Includes employees of business firms, independent consultants, and self-employed chemists.

Table A-26.--Median and quartile incomes of chemists, by age group and level of education, for the principal types of employers, 1951

Type of employer and annual income	All age groups	Under 25 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65 years and over
	Ph.D.										
Colleges and universities:											
Median	$5,600	--	$4,300	$4,900	$5,800	$6,300	$6,300	$6,600	$6,900	$6,600	$6,400
Lower quartile	4,600	--	3,700	4,300	4,900	5,200	5,200	5,300	5,500	5,400	5,400
Upper quartile	7,000	--	4,800	5,800	6,900	7,900	7,800	8,700	9,000	8,700	8,300
Government:											
Median	6,700	(1/)	5,000	5,600	6,400	7,200	7,300	7,800	8,200	8,200	(1/)
Lower quartile	5,600	(1/)	4,100	4,700	5,600	6,100	6,100	6,800	6,600	7,400	(1/)
Upper quartile	8,000	(1/)	5,600	6,500	7,300	8,300	8,800	9,200	9,600	9,600	(1/)
Private industry: 2/											
Median	7,900	--	5,900	6,800	8,500	8,200	10,700	11,400	12,200	11,400	9,800
Lower quartile	6,500	--	5,400	6,100	7,300	7,800	8,000	8,000	8,500	7,300	5,500
Upper quartile	10,900	--	6,500	7,700	10,100	13,400	14,500	15,000+	15,000+	15,000+	15,000+
	Master's degree										
Colleges and universities:											
Median	$4,000	$2,900	$3,500	$3,900	$4,100	$4,400	$4,300	$4,600	$4,800	$5,000	$5,000
Lower quartile	3,300	1,500	3,300	3,300	3,400	3,600	3,500	4,000	3,600	4,200	3,700
Upper quartile	4,900	3,600	4,000	4,600	4,900	5,300	5,200	5,400	6,000	6,400	6,800
Government:											
Median	5,100	(1/)	4,000	4,800	5,300	5,800	5,600	6,000	5,800	6,000	(1/)
Lower quartile	4,200	(1/)	3,400	4,200	4,500	5,000	4,900	5,200	5,200	5,000	(1/)
Upper quartile	6,100	(1/)	4,600	5,700	6,200	6,800	6,700	6,900	7,200	7,500	(1/)
Private industry: 2/											
Median	5,900	4,000	4,500	5,700	6,700	7,600	7,900	9,000	10,900	8,800	8,300
Lower quartile	4,700	3,400	4,100	4,800	5,600	6,100	6,100	6,700	6,000	6,700	5,800
Upper quartile	7,700	4,700	5,100	6,800	8,300	10,300	10,600	13,600	15,000+	15,000+	13,400

See footnotes at end of table.

Table A-26.--Median and quartile incomes of chemists, by age group and level of education, for the principal types of employers, 1951—(Continued)

Type of employer and annual income	All age groups	Under 25 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65 years and over
	Bachelor's degree										
Colleges and universities:											
Median	$3,400	$1,800	$3,200	$3,900	$4,300	$4,100	$4,400	(1/)	(1/)	(1/)	(1/)
Lower quartile	2,100	900	1,800	3,400	3,500	3,300	3,500	(1/)	(1/)	(1/)	(1/)
Upper quartile	4,200	2,800	3,700	4,700	5,400	5,600	5,900	(1/)	(1/)	(1/)	(1/)
Government:											
Median	4,400	3,400	3,600	4,500	5,100	5,300	5,500	$5,800	$6,400	$6,300	$6,300
Lower quartile	3,600	3,000	3,300	3,700	4,300	4,500	4,600	4,600	5,100	5,300	5,500
Upper quartile	5,600	3,700	4,000	5,300	6,000	6,200	6,600	7,000	7,800	7,700	7,500
Private industry: 2/											
Median	5,100	3,500	4,000	5,300	6,300	7,000	7,600	8,900	9,400	8,200	7,500
Lower quartile	4,000	3,100	3,400	4,400	4,200	5,600	6,000	6,400	6,800	6,000	4,900
Upper quartile	6,900	3,900	4,700	6,300	7,900	9,400	11,200	13,800	14,500	14,000	13,000
	Some college										
Colleges and universities:											
Median	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
Lower quartile	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
Upper quartile	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
Government:											
Median	$4,400	(1/)	(1/)	$4,100	$4,700	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
Lower quartile	3,600	(1/)	(1/)	3,500	3,800	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
Upper quartile	5,400	(1/)	(1/)	4,700	5,600	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
Private industry: 2/											
Median	5,400	$3,200	$3,800	4,600	5,700	$6,000	$6,600	$7,300	$7,700	$7,900	$6,900
Lower quartile	4,100	1,900	3,200	3,800	4,600	4,900	5,000	5,500	5,900	5,800	5,100
Upper quartile	7,300	3,700	4,400	5,700	6,100	7,600	9,200	10,500	8,200	10,400	8,700

1/ Too few to compute medians.
2/ Includes employees of business firms, independent consultants, and self-employed chemists.

Table A-27.--Median income of chemists, by age, level of education, and industry, 1951

Age group	Food and kindred products	Paper and allied products	Chemicals and allied products	Rubber products	Machinery (except electrical)	Electrical machinery	Professional and scientific instruments	Petroleum refining	Business and consulting services
	Ph.D.								
All age groups	$8,700	$8,700	$7,900	$7,700	$7,400	$7,100	$8,100	$8,000	$9,600
Under 25 years	(1/)	--	(1/)	--	--	(1/)	(1/)	--	--
25 - 29 years	(1/)	(1/)	5,900	(1/)	(1/)	5,900	(1/)	6,000	(1/)
30 - 34 years	6,100	6,700	6,800	6,700	(1/)	6,500	6,800	7,100	7,400
35 - 39 years	7,900	8,700	8,800	7,600	(1/)	8,500	8,200	8,300	10,000
40 - 44 years	10,300	9,100	9,900	8,000	(1/)	9,500	9,900	10,100	9,500
45 - 49 years	10,600	(1/)	11,400	(1/)	(1/)	(1/)	9,300	10,300	11,600
50 - 54 years	9,400	(1/)	11,700	(1/)	(1/)	(1/)	(1/)	11,600	12,500
55 - 59 years	(1/)	(1/)	12,800	(1/)	--	(1/)	(1/)	(1/)	(1/)
60 - 64 years	(1/)	--	15,000+	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
65 years and over	(1/)	--	9,000	(1/)	--	--	(1/)	(1/)	(1/)
	Master's degree								
All age groups.....	$5,800	$5,600	$6,000	$5,800	$6,000	$5,700	$6,200	$6,100	$5,700
Under 25 years	(1/)	(1/)	4,300	(1/)	--	--	(1/)	(1/)	--
25 - 29 years	4,100	4,600	4,600	(1/)	(1/)	4,300	(1/)	4,800	4,500
30 - 34 years	5,300	5,400	5,700	5,400	(1/)	(1/)	5,700	5,800	5,500
35 - 39 years	6,200	(1/)	6,800	6,300	(1/)	(1/)	7,000	6,800	(1/)
40 - 44 years	7,500	(1/)	8,000	6,600	(1/)	(1/)	(1/)	7,800	(1/)
45 - 49 years	6,700	(1/)	8,400	(1/)	(1/)	(1/)	(1/)	8,500	(1/)
50 - 54 years	(1/)	(1/)	9,000	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
55 - 59 years	(1/)	(1/)	11,100	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
60 - 64 years	(1/)	(1/)	9,200	(1/)	(1/)	(1/)	--	(1/)	(1/)
65 years and over	(1/)	(1/)	(1/)	--	--	(1/)	--	(1/)	(1/)

See footnote at end of table.

Table A-27.--Median income of chemists, by age, level of education, and industry, 1951 (continued)

Age group	Food and kindred products	Paper and allied products	Chemicals and allied products	Rubber products	Machinery (except electrical)	Electrical machinery	Professional and scientific instruments	Petroleum refining	Business and consulting services
	Bachelor's degree								
All age groups	$4,800	$5,300	$5,200	$5,500	$4,700	$4,900	$5,200	$5,600	$5,000
Under 25 years	3,400	3,500	3,500	3,500	(1/)	3,400	3,500	3,900	3,300
25 - 29 years	3,700	4,100	4,000	4,100	3,800	3,900	4,200	4,500	3,600
30 - 34 years	4,800	5,200	5,300	5,400	4,700	5,100	5,600	5,500	4,700
35 - 39 years	6,000	6,400	6,500	6,300	5,800	6,000	6,400	6,600	6,500
40 - 44 years	6,600	7,100	7,300	7,500	5,700	6,600	7,000	7,200	6,600
45 - 49 years	6,400	6,900	8,200	8,200	(1/)	(1/)	(1/)	7,700	7,200
50 - 54 years	7,200	7,800	10,000	8,600	(1/)	(1/)	(1/)	8,000	12,300
55 - 59 years	8,300	(1/)	11,100	10,000	(1/)	(1/)	(1/)	8,000	7,500
60 - 64 years	(1/)	(1/)	10,600	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
65 years and over	(1/)	(1/)	9,200	(1/)	(1/)	--	--	(1/)	(1/)

1/ Too few to compute medians.

Table A -28.--Annual professional income of women chemists, by age group, 1951

Annual income	All age groups	Under 25 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65 years and over
	Percent										
$ 0 - $2,999.....	24.7	52.6	23.5	9.4	11.0	9.8	9.6	10.0	21.7	20.0	(1/)
$3,000 - $3,999.....	38.8	42.2	48.2	37.2	28.7	29.3	24.4	22.5	16.5	16.7	(1/)
$4,000 - $4,999.....	23.0	5.2	25.5	33.4	31.1	29.3	26.9	31.0	22.7	23.3	(1/)
$5,000 - $5,999.....	8.1	--	2.7	16.0	15.5	16.7	21.8	16.3	15.5	20.0	(1/)
$6,000 - $6,999.....	3.1	--	--	3.2	10.0	6.9	8.4	10.9	11.3	10.0	(1/)
$7,000 - $7,999.....	1.3	--	.1	.8	2.7	3.4	3.8	6.2	4.1	6.7	(1/)
$8,000 - $9,999.....	.7	--	--	--	.5	2.3	3.2	2.3	7.2	3.3	(1/)
$10,000 - $14,999.....	.2	--	--	--	--	1.7	1.3	.8	1.0	--	(1/)
$15,000 and over.....	.1	--	--	--	.5	.6	.6	--	--	--	(1/)
Total.....	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	(1/)
Total number reporting.	2/2,831	616	1,021	374	219	174	156	129	97	30	15
Median income.....	$3,700	$2,900	$3,600	$4,100	$4,300	$4,400	$4,600	$4,600	$4,500	$4,600	(1/)
Lower quartile income .	3,000	1,400	3,000	3,400	3,500	3,500	3,600	3,700	3,200	3,300	(1/)
Upper quartile income..	4,500	3,500	4,100	4,900	5,300	5,400	5,600	5,700	5,900	5,800	(1/)

1/ Too few to compute percentages or medians.

2/ Excludes 595 not reporting income, 1 not reporting age, and 1 not reporting age or income.

Table A-29.--Median and quartile incomes of men and women chemists by level of education and age group, 1951

Age groups	All levels of education		Ph.D.		Master's degree		Bachelor's degree		Some college	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
All ages:										
Median	$5,700	$3,700	$7,000	$4,900	$5,500	$3,800	$5,100	$3,500	$5,300	$3,400
Lower quartile	4,400	3,000	5,700	3,800	4,400	3,100	4,000	2,600	4,100	2,400
Upper quartile	7,600	4,500	9,300	5,900	7,200	4,600	6,800	4,100	7,100	3,900
Under 25 years:										
Median	3,500	2,900	5,300	(1/)	3,800	3,100	3,500	2,800	3,300	(1/)
Lower quartile	3,100	1,400	4,400	(1/)	3,300	1,600	3,100	1,400	2,100	(1/)
Upper quartile	3,900	3,500	5,900	(1/)	4,500	3,700	3,900	3,500	3,800	(1/)
25 - 29 years:										
Median	4,200	3,600	5,300	4,000	4,400	3,600	3,900	3,500	3,800	3,300
Lower quartile	3,500	3,000	4,400	3,300	3,800	3,000	3,400	3,000	3,200	2,000
Upper quartile	4,900	4,100	6,000	4,800	5,000	4,100	4,700	4,100	4,500	3,900
30 - 34 years:										
Median	5,500	4,100	6,300	4,600	5,400	4,000	5,200	4,100	4,600	(1/)
Lower quartile	4,500	3,400	5,300	3,700	4,400	3,200	4,300	3,400	3,800	(1/)
Upper quartile	6,600	4,900	7,300	5,600	6,400	4,900	6,200	4,800	5,600	(1/)
35 - 39:										
Median	6,500	4,300	7,600	5,300	6,300	4,200	6,200	4,200	5,600	(1/)
Lower quartile	5,300	3,500	6,200	4,200	5,100	3,500	5,100	3,300	4,500	(1/)
Upper quartile	8,300	5,300	9,400	6,300	7,700	5,000	7,700	4,900	7,000	(1/)
40 - 44 years:										
Median	7,100	4,400	8,400	5,100	6,600	4,200	6,700	4,100	5,900	(1/)
Lower quartile	5,600	3,500	6,600	4,200	5,200	3,500	5,400	3,400	4,800	(1/)
Upper quartile	9,600	5,400	11,500	5,900	8,800	5,000	9,000	4,900	7,400	(1/)

See footnote at end of table

Table A-29.—Median and quartile incomes of men and women chemists by level of education and age group, 1951-(Continued)

Age groups	All levels of education		Ph.D.		Master's degree		Bachelor's degree		Some college	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
45 - 49 years:										
Median	$7,500	$4,600	$8,600	$5,300	$6,500	$4,200	$7,300	$4,100	$6,500	(1/)
Lower quartile	5,700	3,600	6,600	4,200	4,900	3,600	5,600	3,300	5,000	(1/)
Upper quartile	10,700	5,700	12,500	6,300	8,900	5,100	10,300	5,000	9,000	(1/)
50 - 54 years:										
Median	8,000	4,600	8,600	5,000	6,600	4,300	8,300	4,500	7,300	(1/)
Lower quartile	6,000	3,700	6,500	3,900	5,000	3,400	6,000	3,700	5,400	(1/)
Upper quartile	12,300	5,700	12,800	6,400	9,700	5,000	13,000	5,300	10,500	(1/)
55 - 59 years:										
Median	8,300	4,500	8,700	5,300	6,500	4,300	8,800	3,900	7,600	(1/)
Lower quartile	6,000	3,200	6,500	4,200	5,100	2,800	6,400	2,700	5,600	(1/)
Upper quartile	13,200	5,900	13,000	6,700	12,000	5,500	13,900	5,300	12,000	(1/)
60 - 64 years:										
Median	7,500	4,600	7,900	(1/)	6,400	(1/)	7,600	(1/)	7,600	(1/)
Lower quartile	5,600	3,300	6,100	(1/)	4,900	(1/)	5,600	(1/)	5,600	(1/)
Upper quartile	12,100	5,800	12,900	(1/)	9,200	(1/)	12,100	(1/)	13,100	(1/)
65 years and over:										
Median	6,900	(1/)	7,500	(1/)	6,100	(1/)	6,800	(1/)	6,800	(1/)
Lower quartile	5,300	(1/)	5,700	(1/)	4,800	(1/)	5,100	(1/)	4,900	(1/)
Upper quartile	10,100	(1/)	9,900	(1/)	9,600	(1/)	11,400	(1/)	8,800	(1/)

1/ Too few to compute median and quartile.

Table A-30.--Distribution of respondents in chemical engineering, by employment status and field of highest competence, 1951

Field of first competence	Employed		Unemployed		Graduate students		Retired	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	13,314	100.0	28	100.0	977	100.0	27	100.0
Chemical engineering, general	4,950	37.2	24	85.7	827	84.7	15	55.6
Absorption and adsorption	272	2.1	1	3.6	13	1.3	1	3.7
Electrical separation	81	.6	--	--	--	--	1	3.7
Extraction, solvent recovery	516	3.9	1	3.6	25	2.6	2	7.4
Heat transmission (incl. refrigeration)	517	3.9	--	--	22	2.3	1	3.7
Material handling	257	1.9	--	--	3	.3	--	--
Measurement and control of process variables	1,294	9.7	--	--	17	1.7	1	3.7
Mechanical separation	519	3.9	--	--	4	.4	2	7.4
Mixing, kneading, and agitation	156	1.2	--	--	4	.4	1	3.7
Phase, change, separation	1,457	10.9	2	7.1	39	4.0	1	3.7
Size-reduction	99	.7	--	--	2	.2	--	--
Other, n.e.c.	3,196	24.0	--	--	21	2.1	2	7.4

Table A-31.—Level of education of chemical engineers, by age group, 1951

Age group	All levels		Percent of chemical engineers with —			
	Number	Percent	Ph.D.	Master's degree	Bachelor's degree	Some college
Under 25 years	1,026	7.7	0.5	3.9	9.6	5.8
25 - 29 years	4,168	31.4	13.3	33.1	33.2	14.7
30 - 34 years	3,827	28.8	25.1	29.0	29.4	18.7
35 - 39 years	2,030	15.3	23.8	15.9	14.2	17.6
40 - 44 years	975	7.3	13.2	8.5	6.1	17.3
45 - 49 years	544	4.1	10.4	5.0	3.0	10.8
50 - 54 years	370	2.8	6.1	2.8	2.3	7.9
55 - 59 years	203	1.5	4.3	1.0	1.3	5.0
60 - 64 years	108	.8	2.6	.7	.6	1.8
65 years and over	39	.3	.7	.1	.3	.4
Total		100.0	100.0	100.0	100.0	100.0
Total number reporting	1/13,290	.....	954	2,587	9,471	278
Median age	32	.....	37	32	31	38

1/ Does not include 52 chemical engineers who did not report level of education or age.

Table A-32.--Military status of men chemical engineers, by age group, 1951

Age	Total	On active duty	In reserve organizations	Other military status 1/	No present military status		
					Total	Veteran	Non-veteran
	Number						
All ages.....	2/ 13,115	261	3,275	43	9,536	3,587	5,949
20 - 25 years.....	1,615	165	346	5	1,099	617	482
20 years	1	--	—	—	1	1	—
21 years.....	13	--	2	—	11	—	11
22 years.....	135	17	27	2	89	4	85
23 years.....	408	102	59	3	244	28	216
24 years.....	446	28	104	—	314	224	90
25 years.....	612	18	154	—	440	360	80
26 - 34 years.....	7,325	80	2,447	27	4,771	2,542	2,229
26 years.....	810	16	224	1	569	475	94
27 years.....	874	11	287	2	574	476	98
28 years.....	948	8	362	1	577	463	114
29 years.....	892	15	352	3	522	329	193
30 years.....	984	15	384	6	579	276	303
31 years.....	815	4	277	4	530	200	330
32 years.....	709	3	232	4	470	155	315
33 years.....	698	5	214	5	474	102	372
34 years.....	595	3	115	1	476	66	410
35 - 39 years.....	2,007	10	333	4	1,660	153	1,507
40 - 44 years.....	950	4	95	2	849	39	810
45 - 49 years.....	515	--	30	1	484	25	459
50 - 54 years.....	359	1	14	2	342	88	254
55 - 59 years.....	202	1	7	1	193	99	94
60 - 64 years.....	104	--	1	1	102	21	81
65 years and over....	38	--	2	—	36	3	33

See footnotes at end of table.

Table A-32.--Military status of men chemical engineers, by age group, 1951--(Continued)

Age	Total	On active duty	In reserve organizations	Other military status 1/	No present military status		
					Total	Veteran	Non-veteran
	Percent						
All ages.....	100.0	2.0	25.0	0.3	72.7	27.3	45.4
20 - 25 years.....	100.0	10.2	21.4	.3	68.1	38.2	29.9
20 years.....	(3/)	—	—	—	—	—	—
21 years.....	(3/)	—	—	—	—	—	—
22 years.....	100.0	12.6	20.0	1.5	65.9	3.0	62.9
23 years.....	100.0	25.0	14.5	.7	59.8	6.9	52.9
24 years.....	100.0	6.3	23.3	—	70.4	50.2	20.2
25 years.....	100.0	2.9	25.2	—	71.9	58.8	13.1
26 - 34 years.....	100.0	1.1	33.4	.4	65.1	34.7	30.4
26 years.....	100.0	2.0	27.7	.1	70.2	58.6	11.6
27 years.....	100.0	1.3	32.8	.2	65.7	54.5	11.2
28 years.....	100.0	.8	38.2	.1	60.9	48.9	12.0
29 years.....	100.0	1.7	39.5	.3	58.5	36.9	21.6
30 years.....	100.0	1.5	39.1	.6	58.8	28.0	30.8
31 years.....	100.0	.5	34.0	.5	65.0	24.5	40.5
32 years.....	100.0	.4	32.7	.6	66.3	21.9	44.4
33 years.....	100.0	.7	30.7	.7	67.9	14.6	53.3
34 years.....	100.0	.5	19.3	.2	80.8	11.1	68.9
35 - 39 years.....	100.0	.5	16.6	.2	82.7	7.6	75.1
40 - 44 years.....	100.0	.4	10.0	.2	89.4	4.1	85.3
45 - 49 years.....	100.0	—	5.8	.2	94.0	4.9	89.1
50 - 54 years.....	100.0	.3	3.9	.5	95.3	24.5	70.8
55 - 59 years.....	100.0	.5	3.5	.5	95.5	49.0	46.5
60 - 64 years.....	100.0	—	1.0	1.0	98.0	20.2	77.8
65 years and over.....	100.0	—	5.3	—	94.7	7.9	86.8

1/ Such as Retired and Fleet Reserve.
2/ Excludes 190 men chemical engineers not reporting military status.
3/ Too few to compute percentage.

Table A-33.--Military status of men graduate students of chemical engineering, by age group, 1951

Age group	Total	On active duty	In reserve organizations	Other military status 1/	No present military status		
					Total	Veteran	Non-veteran
	Number						
All ages.....	2/ 958	5	250	3	700	348	352
20 - 25 years.....	539	4	123	2	410	143	267
20 years.....	1	—	—	—	1	—	1
21 years.....	25	2	6	—	17	—	17
22 years.....	98	—	25	—	73	—	73
23 years.....	155	1	35	2	117	11	106
24 years.....	155	1	33	—	121	71	50
25 years.....	105	—	24	—	81	61	20
26 - 34 years.....	407	1	125	—	281	201	80
26 years.....	124	1	36	—	87	76	11
27 years.....	100	—	25	—	75	57	18
28 years.....	44	—	15	—	29	20	9
29 years.....	34	—	15	—	19	14	5
30 years.....	35	—	12	—	23	11	12
31 years.....	31	—	8	—	23	13	10
32 years.....	15	—	6	—	9	5	4
33 years.....	11	—	5	—	6	—	6
34 years.....	13	—	3	—	10	5	5
35 - 39 years.....	12	—	2	1	9	4	5

See footnotes at end of table.

Table A-33.—Military status of men graduate students of chemical engineering by age group, 1951—(Continued)

Age group	Total	On active duty	In reserve organizations	Other military status 1/	No present military status		
					Total	Veteran	Non-veteran
	Percent						
All ages.....	100.0	0.5	26.1	0.3	73.1	36.3	36.8
20 - 25 years.....	100.0	.8	22.8	.4	76.0	26.5	49.5
20 years.....	(3/)	(3/)	(3/)	(3/)	(3/)	(3/)	(3/)
21 years.....	100.0	8.0	24.0	—	68.0	—	68.0
22 years.....	100.0	—	25.5	—	74.5	—	74.5
23 years.....	100.0	.6	22.6	1.3	75.5	7.1	68.4
24 years.....	100.0	.6	21.3	—	78.1	45.8	32.3
25 years.....	100.0	—	22.9	—	77.1	58.1	19.0
26 - 34 years.....	100.0	.2	30.7	—	69.1	49.4	19.7
26 years.....	100.0	.8	29.0	—	70.2	61.3	8.9
27 years.....	100.0	—	25.0	—	75.0	57.0	18.0
28 years.....	100.0	—	34.1	—	65.9	45.4	20.5
29 years.....	100.0	—	44.1	—	55.9	41.2	14.7
30 years.....	100.0	—	34.3	—	65.7	31.4	34.3
31 years.....	100.0	—	25.8	—	74.2	41.9	32.3
32 years.....	(3/)	(3/)	(3/)	(3/)	(3/)	(3/)	(3/)
33 years.....	(3/)	(3/)	(3/)	(3/)	(3/)	(3/)	(3/)
34 years.....	(3/)	(3/)	(3/)	(3/)	(3/)	(3/)	(3/)
35 - 39 years.....	(3/)	(3/)	(3/)	(3/)	(3/)	(3/)	(3/)

1/ Such as Retired, Fleet Reserve, etc.
2/ Excludes 17 not reporting military status.
3/ Too few to compute percentage.

Table A-34.--Fields of education of chemical engineers, by level of education, 1951

Major subject for highest degree	All levels of education		Percent of chemical engineers with --			
	Number	Percent	Ph.D.	Master's degree	Bachelor's degree	Some college
Physical sciences	1,167	8.8	20.2	7.7	7.6	24.0
Chemistry (including biochemistry)	1,100	8.3	19.2	7.0	7.2	22.0
Mathematics	12	.1	.2	.1	.1	.8
Metallurgy	19	.2	.5	.1	.1	.8
Physics, geophysics, and crystallography	18	.1	.2	.3	.1	.4
All others	18	.1	.1	.2	.1	—
Agricultural sciences	14	.1	.1	.2	.1	.4
Biological sciences	17	.1	—	.1	.1	.8
Medical sciences	5	(1/)	—	(1/)	(1/)	.8
Engineering and architecture	11,970	90.3	79.7	89.9	91.9	71.6
Chemical and ceramic	11,716	88.4	78.3	87.3	90.3	64.5
All others	254	1.9	1.4	2.6	1.6	7.1
Social sciences	75	.6	—	2.1	.2	2.0
Business administration	49	.4	—	1.5	.1	1.2
Education	12	.1	—	.4	(1/)	.4
All other	14	.1	—	.2	.1	.4
Other	10	.1	—	—	.1	.4
Total	--	100.0	100.0	100.0	100.0	100.0
Total number reporting	2/13,258	—	954	2,586	9,463	254

1/ Too few to compute percentage.

2/ Does not include 32 not reporting field of education, 8 not reporting level of education, and 44 who reported neither. The totals in column 1 include 1 chemical engineer who had not taken any college courses.

Table A-35.--Industries in which chemical engineers were employed, 1951

Field of industry	Number	Percent
All industries	1/ 11,695	100.0
Metal mining	22	.2
Coal mining	14	.1
Crude petroleum and natural gas	107	.9
Mining and quarrying of nonmetals	34	.3
Construction	72	.6
Ordnance and accessories	21	.2
Food and kindred products	416	3.6
Tobacco	11	.1
Textile mill products	88	.8
Paper and allied products	349	3.0
Printing, publishing, and allied products	20	.2
Chemicals	4,757	40.7
Industrial inorganic and organic	3,345	28.6
Drugs and medicine	394	3.4
Soaps and glycerin	184	1.6
Paints and varnishes	171	1.5
Gum and wood chemicals	18	.1
Fertilizers	60	.5
Vegetable and animal oils	80	.7
Miscellaneous	505	4.3
Petroleum and coal products	2,084	17.8
General petroleum	3	(2/)
Petroleum refining	1,997	17.1
Coke and byproducts	31	.3
Paving and roofing	23	.2
All other petroleum products	30	.2
Rubber products	202	1.7
Stone, clay, and glass	200	1.7
Primary metal industries	197	1.6
Fabricated metal products	58	.5
Machinery (except electrical)	431	3.7
Electrical machinery	252	2.2
Transportation equipment	83	.7
Professional and scientific instruments	183	1.6
All other manufacturing group	501	4.3
Utilities and sanitary services	71	.6
Business services 3/	145	1.2
Educational services	442	3.8
Miscellaneous services	414	3.5
Engineering and architecture	289	2.5
Nonprofit educational and scientific research	125	1.0
Government	460	3.9
All other 4/	61	.5

1/ Excludes 6 not reporting industry.
2/ Less than 0.05 percent.
3/ Includes commercially operated research agencies and testing laboratories.
4/ This category includes very small groups of chemical engineers employed in transportation, trade, banking, membership organizations, etc.

Table A-36.—Industries in which chemical engineers were employed, by level of education, 1951

Industries	All levels of education	Ph.D.	Master's degree	Bachelor's degree	Some college
	Percent				
Manufacturing	84.3	58.8	81.1	87.6	89.8
Chemicals	40.7	29.2	40.7	41.8	44.0
Petroleum	17.9	13.1	19.5	18.1	9.6
Machinery	5.8	3.9	5.0	6.2	7.3
Other manufacturing	19.9	12.6	15.9	21.5	28.9
Research and consulting services	4.8	6.4	6.5	4.2	3.7
Educational institutions	3.8	30.1	5.5	.7	.5
Government	3.9	2.7	3.8	4.1	3.2
Other industries	3.2	2.0	3.1	3.4	2.8
Total	100.0	100.0	100.0	100.0	100.0
Total number reporting	1/ 11,652	854	2,329	8,251	218

1/ Excludes 43 not reporting level of education and 6 not reporting industry.

Table A-37.--Functions of chemical engineers, by industry, 1951

Industry	All functions		Percent of chemical engineers in--									
	Number	Percent	Research and development	Consulting	Management	Teaching	Technical writing	Design	Analysis and testing	Production	Technical sales and services	Other
All industries	1/ 11,664	100.0	30.5	4.0	10.1	3.2	0.6	12.5	6.6	27.6	2.8	2.1
Manufacturing	9,828	100.0	30.6	3.2	10.4	(2/)	.5	12.5	7.0	30.7	2.8	2.3
Food	416	100.0	34.2	1.4	13.0	--	.2	5.5	8.4	33.5	1.4	2.4
Paper and allied products	348	100.0	31.9	.6	11.2	--	.3	5.2	16.4	30.1	1.1	3.2
Chemicals	4,746	100.0	30.7	2.6	10.4	(2/)	.2	11.7	4.9	35.9	1.6	2.0
Petroleum	2,081	100.0	26.6	6.4	9.6	--	.8	16.7	7.7	28.5	2.2	1.5
Rubber	202	100.0	41.1	1.0	9.4	--	--	4.9	9.4	29.7	1.0	3.5
Stone, clay, and glass products	200	100.0	29.5	2.0	13.5	--	--	5.0	19.5	24.5	4.0	2.0
Primary metals	197	100.0	34.6	3.0	16.8	--	.5	3.6	9.1	26.4	3.0	3.0
Machinery (except electrical)	431	100.0	23.7	2.6	9.0	--	.9	32.7	4.6	6.5	18.6	1.4
Electrical machinery	252	100.0	34.1	1.6	9.9	.4	.8	3.2	15.1	23.4	3.2	8.3
All other	955	100.0	35.9	2.2	9.9	.1	1.6	10.9	7.3	24.1	4.5	3.5
Research and consulting services	559	100.0	33.1	19.3	8.8	--	.5	25.4	2.5	5.2	4.3	.9
Educational institutions	442	100.0	14.0	--	3.4	81.7	--	--	.5	.2	--	.2
Colleges and universities	442	100.0	14.0	--	3.4	81.7	--	--	.5	.2	--	.2
Government	460	100.0	52.2	5.2	9.4	.9	1.7	5.4	7.8	16.5	--	.9
Other industries, not elsewhere classified	375	100.0	19.2	5.6	11.7	--	1.1	17.6	8.3	24.8	8.3	3.4

1/ Excludes 32 not reporting function; 3 not reporting industry, and 2 reporting neither.
2/ Less than 0.05 percent.

Table A-38.--Functions performed by chemical engineers, by level of education, 1951

Function	All levels of education	Ph.D.	Master's degree	Bachelor's degree	Some college
	Percent				
Research and development	30.6	38.1	36.7	28.4	20.1
Consulting	4.0	4.0	4.6	3.9	2.3
Management	10.0	14.4	9.5	9.5	14.6
Teaching	3.2	26.6	4.5	.5	—
Technical writing	.6	.5	.5	.5	1.4
Design	12.5	9.0	16.4	11.9	8.2
Analysis and testing	6.6	1.4	3.9	7.9	9.1
Production	27.6	4.8	19.9	31.8	38.8
Technical sales and services	2.8	1.2	2.7	3.0	3.7
Other	2.1	—	1.3	2.6	1.8
Total	100.0	100.0	100.0	100.0	100.0
Total number reporting	1/11,625	853	2,324	8,229	219

1/ Excludes 33 not reporting function and 43 not reporting level of education.

Table A-39.--Age of chemical engineers, by function performed, 1951

Age group	Percent of chemical engineers in--									
	All functions	Research and development	Consulting	Management	Teaching	Technical writing	Design	Analysis and testing	Production	Technical sales and services
Under 25 years ...	6.5	8.0	1.7	0.8	1.4	1.5	4.2	9.7	6.7	6.3
25 - 29 years ...	31.3	36.9	22.9	7.6	12.7	32.3	29.9	44.5	32.4	29.8
30 - 34 years ...	29.9	31.6	29.3	18.2	31.1	30.8	36.2	24.1	32.1	32.9
35 - 39 years ...	15.7	12.7	17.8	27.5	19.0	13.9	17.6	10.0	16.1	12.7
40 - 44 years ...	7.3	5.2	9.0	15.1	14.3	12.3	6.5	4.9	6.9	8.7
45 - 49 years ...	4.1	2.6	7.5	12.8	11.4	6.2	2.7	2.5	2.5	2.7
50 - 54 years ...	2.7	1.7	4.3	9.2	4.1	1.5	1.5	3.2	1.7	3.6
55 - 59 years ...	1.5	.8	3.2	5.6	3.3	1.5	.9	.7	1.0	1.5
60 - 64 years ...	.7	.4	2.4	1.9	2.4	--	.5	.3	.6	.6
65 years and over	.3	.1	1.9	1.3	.3	--	--	.1	(1/)	1.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total number reporting.....	2/11,665	3,564	467	1,174	369	65	1,455	771	3,222	332
Median age	32	31	34	39	36	33	32	29	32	32

1/ Less than 0.05 percent.

2/ Excludes 34 not reporting function and 2 not reporting age. Includes 246 reporting a function other than those listed above.

Table A-40.--Annual professional income of chemical engineers, by age group, 1951

Annual income	Percent of chemical engineers--										
	All age groups	Under 25 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65 years and over
$ 0 - $ 2,999 ..	0.8	5.5	0.8	0.2	0.2	0.3	0.3	--	--	1.5	--
$ 3,000 - $ 3,999 ..	14.8	59.6	26.4	6.4	1.1	.6	--	0.4	--	--	8.0
$ 4,000 - $ 4,999 ..	21.8	30.6	39.9	18.3	5.7	5.0	1.7	2.2	0.8	3.1	--
$ 5,000 - $ 5,999 ..	20.1	3.9	23.6	28.9	15.6	9.4	6.4	7.8	7.5	1.5	--
$ 6,000 - $ 6,999 ..	14.6	.2	7.2	22.8	21.7	17.4	13.4	9.1	7.5	10.8	4.0
$ 7,000 - $ 7,999 ..	9.2	--	1.4	12.8	18.2	16.6	12.0	9.9	9.8	13.8	4.0
$ 8,000 - $ 9,999 ..	8.4	--	.5	7.5	20.5	21.2	17.9	15.5	15.8	9.3	12.0
$10,000 - $14,999 ..	6.8	--	.2	2.7	14.0	20.5	28.2	25.4	30.0	29.2	20.0
$15,000 and over ...	3.5	.2	(1/)	.4	3.0	9.0	20.1	29.7	28.6	30.8	52.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total number reporting	2/9,270	640	2,980	2,776	1,404	657	358	232	133	65	25
Median income	$5,600	$3,700	$4,600	$5,900	$7,300	$8,100	$9,800	$11,000	$11,400	$11,700	$15,000+
Lower quartile income	4,400	3,300	3,900	5,000	6,100	6,600	7,300	7,600	7,900	7,600	9,500
Upper quartile income	7,300	4,300	5,300	6,900	9,200	11,100	14,100	15,000+	15,000+	15,000+	15,000+

1/ Less than 0.05 percent.
2/ Excludes 2,388 not reporting income and 43 not reporting age.

Table A-41.—Median and quartile incomes of chemical engineers, by level of education and age group, 1951

Age group	All levels of education	Ph.D.	Master's degree	Bachelor's degree	Some college
All ages:					
Median 1/	$ 5,600	$ 7,900	$ 5,900	$ 5,400	$ 6,100
Lower quartile	4,400	6,300	4,800	4,200	4,800
Upper quartile	7,300	11,300	7,500	6,900	8,600
Under 25 years:					
Median	3,700	(2/)	4,400	3,700	(2/)
Lower quartile	3,300	(2/)	4,000	3,300	(2/)
Upper quartile	4,300	(2/)	4,800	4,200	(2/)
25 - 29 years:					
Median	4,600	5,900	4,900	4,400	4,600
Lower quartile	3,900	5,400	4,300	3,700	3,900
Upper quartile	5,300	6,600	5,600	5,100	5,400
30 - 34 years:					
Median	5,900	6,700	6,100	5,800	5,100
Lower quartile	5,000	5,700	5,200	4,900	4,400
Upper quartile	6,900	7,900	7,200	6,800	5,900
35 - 39 years:					
Median	7,300	8,800	7,500	7,100	5,200
Lower quartile	6,100	7,100	6,300	6,000	5,300
Upper quartile	9,200	11,800	9,300	8,900	7,000

See footnotes at end of table.

Table A-41.—Median and quartile incomes of chemical engineers, by level of education and age group, 1951-(Continued)

Age group	All levels of education	Ph.D.	Master's degree	Bachelor's degree	Some college
40 - 44 years:					
Median	8,100	9,500	8,600	7,700	7,500
Lower quartile	6,600	7,700	7,000	6,300	6,300
Upper quartile	11,100	13,400	11,700	10,400	9,600
45 - 49 years:					
Median	9,800	10,500	10,700	9,500	(2/)
Lower quartile	7,300	8,200	7,000	7,100	(2/)
Upper quartile	14,100	14,800	15,000 +	13,500	(2/)
50 - 54 years:					
Median	11,000	12,000	10,500	10,600	(2/)
Lower quartile	7,600	8,300	6,800	7,500	(2/)
Upper quartile	15,000 +	15,000 +	15,000 +	15,000 +	(2/)
55 - 59 years:					
Median	11,400	11,300	(2/)	10,800	(2/)
Lower quartile	7,900	7,700	(2/)	7,600	(2)
Upper quartile	15,000 +	15,000 +	(2/)	14,200	(2/)
60 - 64 years:					
Median	11,700	(2/)	(2/)	10,800	(2/)
Lower quartile	7,600	(2/)	(2/)	7,300	(2/)
Upper quartile	15,000 +	(2/)	(2/)	15,000 +	(2/)
65 years and over:					
Median	15,000 +	(2/)	(2/)	14,000	(2/)
Lower quartile	9,500	(2/)	(2/)	9,000	(2/)
Upper quartile	15,000 +	(2/)	(2/)	15,000 +	(2/)

1/ Median rounded to nearest hundred.
2/ Less than 20 reporting.

Table A-42.—Median income of chemists and chemical engineers, by level of education and age group, 1951

Age group and level of education	Chemists	Chemical engineers
All ages:		
Ph.D.	$ 7,000	$ 7,900
Master's	5,400	5,900
Bachelor's	4,900	5,400
No degree	5,000	6,100
Under 25 years:		
Ph.D.	5,200	(1/)
Master's	3,600	4,400
Bachelor's	3,400	3,700
No degree	3,200	(1/)
25 - 29 years:		
Ph.D.	5,300	5,900
Master's	4,300	4,900
Bachelor's	3,900	4,400
No degree	3,700	4,600
30 - 34 years:		
Ph.D.	6,200	6,700
Master's	5,300	6,100
Bachelor's	5,100	5,800
No degree	4,600	5,100
35 - 39 years:		
Ph.D.	7,600	8,800
Master's	6,200	7,500
Bachelor's	6,100	7,100
No degree	5,600	6,200

See footnote at end of table.

Table A-42.--Median income of chemists and chemical engineers, by level of education and age group, 1951--(Continued)

Age group and level of education	Chemists	Chemical engineers
40 - 44 years:		
Ph.D.	8,300	9,500
Master's	6,500	8,600
Bachelor's	6,700	7,700
No degree	5,900	7,500
45 - 49 years:		
Ph.D.	8,300	10,500
Master's	6,100	10,700
Bachelor's	7,200	9,500
No degree	6,500	(1/)
50 - 54 years:		
Ph.D.	8,300	12,000
Master's	6,300	10,500
Bachelor's	8,000	10,600
No degree	7,100	(1/)
55 - 59 years:		
Ph.D.	8,400	11,300
Master's	6,000	(1/)
Bachelor's	8,500	10,800
No degree	7,500	(1/)
60 - 64 years:		
Ph.D.	7,700	(1/)
Master's	6,000	(1/)
Bachelor's	7,500	10,800
No degree	7,600	(1/)
65 years and over:		
Ph.D.	7,400	(1/)
Master's	5,800	(1/)
Bachelor's	6,800	14,000
No degree	6,800	(1/)

1/ Too few to compute medians.

Table A-43.—Median and quartile incomes of chemical engineers, by age group for the principal types of employer, 1951

Type of employer and annual income	All age groups	Under 25 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65 years and over
Colleges and universities:											
Median	$6,100	(1/)	$4,300	$5,400	$6,800	$8,100	$9,200	(1/)	(1/)	(1/)	(1/)
Lower quartile .	4,700	(1/)	3,600	4,400	5,600	6,500	6,900	(1/)	(1/)	(1/)	(1/)
Upper quartile .	8,400	(1/)	5,000	6,500	8,100	10,800	12,900	(1/)	(1/)	(1/)	(1/)
Government:											
Median	5,000	$ 3,300	4,000	5,200	6,200	6,100	(1/)	(1/)	(1/)	(1/)	(1/)
Lower quartile .	4,000	2,500	3,500	4,400	5,300	4,900	(1/)	(1/)	(1/)	(1/)	(1/)
Upper quartile .	6,300	3,700	4,600	5,900	6,900	7,600	(1/)	(1/)	(1/)	(1/)	(1/)
Private industry:											
Median	5,700	3,800	4,600	5,900	7,400	8,200	10,300	$12,200	$12,400	$12,700	$15,000 +
Lower quartile .	4,500	3,400	4,000	5,000	6,200	6,700	7,400	8,400	9,000	7,900	9,500
Upper quartile .	7,400	4,400	5,400	7,000	9,400	11,500	14,400	15,000+	15,000+	15,000+	15,000 +

1/ Too few to compute medians and quartiles.

Table A-44.--Median income of chemical engineers with bachelor's degree only, by age and industry, 1951

Age group	Food and kindred products	Paper and allied products	Chemicals and allied products	Stone, clay, and glass products	Primary metals	Machinery, except electrical	Electrical machinery	Professional and scientific instruments	Petroleum refining	Engineering, consulting, and other business services
All age groups	$5,200	$5,300	$5,600	$5,200	$5,800	$5,900	$4,800	$5,200	$5,900	$7,300
Under 25 years ...	3,600	3,600	3,800	(1/)	(1/)	3,800	(1/)	(1/)	4,200	(1/)
25 - 29 years ...	4,200	4,400	4,600	4,200	4,100	4,500	4,000	4,300	5,000	4,800
30 - 34 years ...	5,300	5,300	6,000	5,400	5,800	5,900	5,400	5,700	6,000	6,900
35 - 39 years ...	7,600	7,000	7,400	(1/)	6,800	7,900	7,800	(1/)	7,500	8,600
40 - 44 years ...	7,500	8,500	8,600	(1/)	(1/)	8,200	(1/)	(1/)	8,000	10,800
45 - 49 years ...	(1/)	(1/)	10,600	(1/)	(1/)	(1/)	(1/)	(1/)	9,800	(1/)
50 - 54 years ...	(1/)	(1/)	13,000	(1/)	(1/)	(1/)	(1/)	—	11,200	15,000 +
55 - 59 years ...	(1/)	(1/)	13,100	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
60 - 64 years ...	(1/)	(1/)	15,000 +	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)	(1/)
65 years and over	(1/)	(1/)	—	(1/)	(1/)	(1/)	(1/)	(1/)	—	(1/)
Median age	32	32	31	33	33	33	29	31	32	34

1/ Too few to compute medians.

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