1973

Report of Chemists' Salaries and Employment Status

Based on the 1973 Combined Salary/Employment Status Survey of ACS Members.

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Washington, D.C.

1973 REPORT

OF CHEMISTS' SALARIES

AND EMPLOYMENT STATUS

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This report has been prepared as a service of the Department of Professional Relations and Manpower Studies, American Chemical Society.

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C O N T E N T S

1973 Combined Salary/Employment Status Report

I. Introduction and Overview

A. Background

The 1973 Comprehensive Salary and Employment Status Survey is a continuation in the series of surveys conducted by the American Chemical Society since 1941. These surveys help to analyze the economic status of the chemist and chemical engineer. Starting in 1971, in addition to the recurring survey for salary information, a second survey was conducted which primarily sought information about unemployment. These two surveys have been combined and extended for the current year. It is expected that the composite survey will continue annually in ensuing years.

The results of this survey should not be the sole source of information for anyone seeking data on the economic status of chemists and chemical engineers. Other groups such as the Bureau of Labor Statistics, the National Science Foundation, the American Institute of Chemical Engineers, and the Engineering Manpower Commission of the Engineers Joint Council generate material which must be considered in any appraisal of the employment situation of chemists.

The employment pattern for technical manpower undergoes a feast/famine cycle. The officers, staff and committees of the American Chemical Society (and a good many other groups) have for the past few years been struggling to combat a high unemployment rate (3% in 1972) for chemists. The range of possible solutions to the problem stretch from stringent control of new entrants to the field to a laissez-faire self-correcting marketplace atmosphere. All have been mentioned in the past and may pass into oblivion when the market picks up.

There are today about 200,000 chemists, chemical engineers, and biochemists in the United States. Each year approximately 20,000 people take degrees at some level in these areas and about 50% of them seek jobs in the profession. Each year 1.8% of chemists die or retire. On the basis of the 1960 census report concerning chemists (and a follow up study) there is presumed to be a 2.3% transfer rate out of the field of chemistry, so it is seen that the total attrition is about 4% a year. Growth of new jobs in chemistry, beyond replacement for attrition, would be deemed high if the annual increment were 4%; it would be low at 2%; (Alberty in Scientific Manpower: A Dilemma for Graduate Education). These figures demonstrate the rather critical balance that exists for the employment picture in chemistry.

Recent reports of the College Placement Council indicate recruitment is up this year. The 1972 Starting Salary Survey, conducted by the ACS, indicated an improving situation for chemists and chemical engineers in the class of 1972. The Deutsch-Shea-Evans Index shows that the demand for scientists and engineers, as evinced by "help wanted" advertisements, is on the rise. On the other hand, there are continuing layoffs and there are projected layoffs. These factors indicate that the problem for the new graduate is perhaps resolved. The problem for the laid-off older chemist continues.

B. The Survey

The combined Comprehensive Salary and Employment Status Survey for 1973 was sent to 21,641 members of the American Chemical Society. Students, emeritus, and foreign members were excluded from this survey; the sample represents 25% of the sample universe. Usable returns (in whole or in part) from 11,792 (54.5%), were received prior to the cutoff date of April 16. Respondents were asked to report their status as of March 1, 1973. The 11,792 returns were manually edited, keypunched, edited by computer, and processed by computer for this report.

A copy of the survey form is included in this report (Appendix 1). Respondents were cautioned not to sign the return so as to preserve the anonymity of the information.

This year's form differed from previous surveys, in that questions were asked concerning minority group, unemployment insurance, the respondent's opinion of the job market outlook, and ACS dues and services related data.

(1) Employment

The rate of unemployment among survey respondents has decreased appreciably (from 3.0% in 1972 to 1.7% in 1973). This follows the improvement in starting salaries and employment status noted in our survey of 1972's graduating class. (See Chemical and Engineering News, October 2, 1972.)

(2) Salaries

Incomes of chemists and chemical engineers improved when compared to last year's figures, but in the light of the general inflation projected for 1973, one must calculate the real gain. The index of consumer prices was 120 in March 1971, 124 in March 1972, and 130 in March 1973. Therefore, when the 7.5% increase in chemists' salaries shown by our survey is adjusted for the 4.8% increase in CPI since March, 1972, the real salary gain is only 2.7%. On the other hand, the 7.5% raise exceeds the federal guideline of 5.5%. This may be accounted for in several ways none of which can be certified by our survey.

A trend has been developing in the past few years and now it is clear that chemists employed in government are in general the best paid category of ACS members when grouped by employer type. Table S-1 shows the median salaries of ACS chemists for the years 1969-1973.

(3) Minorities

Our survey indicates that minorities and women are for the most part under-represented among chemists and paid at a lower level. A separate study based on 6,000 returns showed that the unemployment rate for minorities and women was greater than that for non-minority males.

II. Employment Status

In this section we examine in detail the demographic, educational and economic factors that affect employment status, in particular unemployment. Here are the tallies of some questions relating to unemployment experience. (11,780 responses are evaluated in each question.)

Have you been unemployed at any time since January 1, 1969?

Yes	No	No Response
1409	10108	263

Have you voluntarily changed employers since January 1, 1969?

Yes	No	No Response
2095	9306	379

Have there been cutbacks of chemists at your work location in the following years?

	Yes	No	No Response
1969	1923	7233	2624
1970	2991	6713	2076
1971	3551	6582	1647
1972	2904	7211	1665

How do you view the job market in 1973-1976?

247 Excellent; 4345 Good; 5204 Poor; 1661 No Opinion; 323 NR

In 1972 our survey showed 71% of respondents did not change jobs in the four previous years. In 1973, 79% did not change jobs voluntarily. The 1972 survey asked for information back to 1968, not a traumatic year for employment, while this year's survey only deals with the worsening employment period, 1969-1972. Twelve percent of the respondents indicate some unemployment since January 1, 1969. In each of the years since 1968, more than 20% of chemists have witnessed a

cutback at their place of work. No wonder 53% of those giving an opinion feel the employment outlook is bad. In addition, 21.9% said they had used the employment aids available through the ACS, while 75.6% did not. Three and one half percent indicated they are using these employment aids currently -- an indication of mobility or job dissatisfaction, since 88.7% of the employment aid users are full-time employed and only 1.7% are unemployed.

E-1 Employment Status of ACS Members

	% 1971	% 1972	% 1973**	% B.S. 1973	% M.S. 1973	% Ph.D. 1973
Full-time employed	88.2	88.0	88.7	90.3	88.0	88.1
Unemployed	2.7	3.0	1.7	1.7	2.2	1.5
Temporarily/part-time employed	2.2	1.5	1.3	0.9	1.4	1.5
Subprofessionally employed	2.4	2.7	2.0	2.6	3.1	1.2
Post-doctoral/fellowship	1.6	2.0	2.9	0.6	0.8	5.1
Retired, seeking employment	-	0.4	0.4	0.6	0.5	0.3
Retired, not seeking employment	2.6*	2.2	3.0	3.2	4.1	2.4
No Report	0.3	0.2	-	-	-	-

8.3

* Includes those retired but seeking employment.

** 11,780 returns: 64 no degree, 14 no response to degree (all full-time employed); 3,487 B.S., 2,327 M.S., 5,883 Ph.D.

Table E-1 shows the improvement that was made in employment between March 1972 and March 1973. Increased recruiting and a dramatic rise in "help wanted" advertising, along with a strong improvement in the employment of recent graduates (indicated by our Starting Salary Survey in Summer 1972) foretold such a result, but did not indicate as strong an improvement as has occurred. The number of those retired and not seeking employment has increased, but we can only surmise that forced retirement may account for this change.

135

Using Table E-1 and the Bureau of Labor Statistics estimate of 187,000 chemists and chemical engineers in the U.S., we estimate there are about 3,200 unemployed chemists and chemical engineers in the U.S. today. Using a higher estimate of 200,000 chemists and chemical engineers, (based on degrees conferred in the past 40 years,

the National Register of Scientific and Technical Personnel and studies of ACS membership) we calculate some 3,400 unemployed chemists and chemical engineers in the U.S. (The rate of unemployment for engineers is 1.2%, significantly below that for chemists and others.)

There has also been a noticeable decrease in "subprofessional" employment (current range 3,700 to 4,000) and "temporary or part-time" employment (current range 2,400 to 2,600) since last year. Thus, there may be 9,400 to 10,000 chemists who are unemployed or in "unsatisfactory" employment. On the other hand, if we suppose that 1% unemployment for chemists is a "full" employment rate (some people do not want professional full-time employment) and the same factor holds for those subprofessionally, temporarily or part-time employed by choice, then the range of unsatisfactory employment situations among chemists is 3,700 to 4,000. (i.e., subtracting out the 1% in each case we have "real" unemployment is 0.7%, "real" subprofessional employment is 1%, and "real" temporary employment is 0.3%. Total "real unsatisfactory" employment is 2% of all chemists.)

Table E-1 also shows that chemists at the M.S. level seem to fare worst in regard to employment status.

E-2 Age/Degree Total Sample

Age	B.S.	M.S.	Ph.D.	Total	%
Under 25	84	10	16	110	0.9
25-30	430	258	495	1183	10.1
31-35	362	290	1204	1856	15.9
36-40	331	247	882	1460	12.5
41-45	425	304	849	1578	13.5
46-50	517	346	696	1559	13.3
51-55	564	298	627	1489	12.7
56-60	645	469	809	1923	16.4
Over 60 & No Response	129	105	305	539	4.6
Total	3487	2327	5883	11697	

A. Age

Interestingly, more respondents neglected to answer the "date of birth" question than the ethnic questions. Our 1972 Starting Salary Survey showed a healthy increase in employment for those under 25. This survey reaffirms the upward swing for the younger

chemists. While age discrimination is rather difficult to demonstrate on a case by case basis, there are studies (e.g., Thompson, The Effects of Unemployment on Engineering Careers) which show that length of unemployment varies directly with age. Technical obsolescence occurs, but again, on an individual basis it might be difficult to demonstrate. (Harvard Business Review, September/October, 1971, page 57.)

E-3 Unemployed By Gender, Degree, Age

	Total Sample	Bachelors M	Bachelors F	Masters M	Masters F	Doctors M	Doctors F	Overall M	Overall F	% Unemployed	% of Age Group Unemployed 1972	% of Age Group Unemployed 1973
Under 25	110	1	1	-	1	-	-	1	2	1.5	23.7	2.7
25-30	1183	11	3	8	6	5	1	24	10	17.2	3.6	2.9
31-35	1856	3	1	3	2	17	9	23	12	17.7	3.2	1.9
36-40	1460	4	1	5	-	5	2	14	3	8.6	2.0	1.2
41-45	1578	9	1	8	-	12	1	29	2	15.7	2.8	2.0
46-50	1559	10	-	6	-	12	3	28	3	15.7	2.5	2.0
51-55	1489	10	1	5	-	6	-	21	1	11.1	2.5	1.5
56-60	1923	2	-	7	-	8	-	17	-	8.6	2.6	0.9
Over 60 & no response to age	539	3	-	-	-	4	1	7	1	4.0	1.4	1.5
Total	11697	53	8	42	9	69	17	164	34			

198 Total Unemployed

Note: All who reported "no degree" are employed.

For those aged 36-40 and 56-60, the unemployment level looks healthy; for those 30 and below, there is a significantly higher rate. Those below age 36 account for 36.4% of the unemployed, but represent only 26.9% of the respondents.

B. Gender

The proportion of ACS members who are females will probably grow in the future. A study of Earned Degrees Conferred shows that the number of women taking degrees in chemistry is going up.

Previous studies by the ACS Manpower Office and others, indicate that women are more inclined to pursue a Masters degree than their male counterparts. They also get degrees at a younger age. Women move into teaching at a higher rate than men.

E-4 Gender/Degree

	B.S.	M.S.	Ph.D.	Total	%
Male	3200	2065	5608	10873	93.0
Female	285	259	269	813	7.0
No Response	2	3	6	11	0.1
Total	3487	2327	5883	11697	
Unemployed					
Male	53(1.7)*	42(2.0)	69(1.2)	164(1.5)	
Female	8(2.8)	9(3.5)	17(6.3)	34(4.2)	
No Response					

* % of Total who are unemployed in this category

This survey's distribution of women by employer type is: Industry 42%, Education 37%, Government 14%, Nonprofit Organizations 7%, (Self-Employeds did not provide sufficient data for estimation of percentage). For male respondents the distribution is: Industry 62%, Education 23%, Government 10%, and Nonprofit 4%, less than 1% are self employed. These distributions have not changed since 1972.

Distribution by gender and work activity for females is: Management 5.4%, R&D 42.5%, Teaching 33.8%, Marketing and Production 17.6%, Other 0.7%. For male respondents the distribution is: Management 18.5%, R&D 45.8%, Teaching 21.1%, Marketing and Production 14.3%, Other 0.3%.

The distribution of women by field is: Analytical 2.3%, Inorganic 9.0%, Organic 14.2%, Physical 7.9%, Biochemistry 20.4%, Polymer 3.3%, Other 21.7%. For males we have: Analytical 19.2%, Inorganic 6.5%, Organic 24.5%, Physical 11.3%, Biochemistry 12.4%, Polymer 10.7%, Other 15.4%. When compared to last year's survey, these distributions show a shift from teaching to R&D on the part of women and the reverse for men. Among women there may be a shift from biochemistry and analytical chemistry to the catchall "other" category.

C. Employer

Table E-5 shows that employment has picked up slowly in industry, compared with other categories. The industrial unemployment rate is still 2.6%, where others show an acceptable unemployment level. Contrary to the situation last year, when unemployment in industry approximated unemployment for all respondents, this year industry far exceeds the average, and thus imposes the unacceptable rate on the profession.

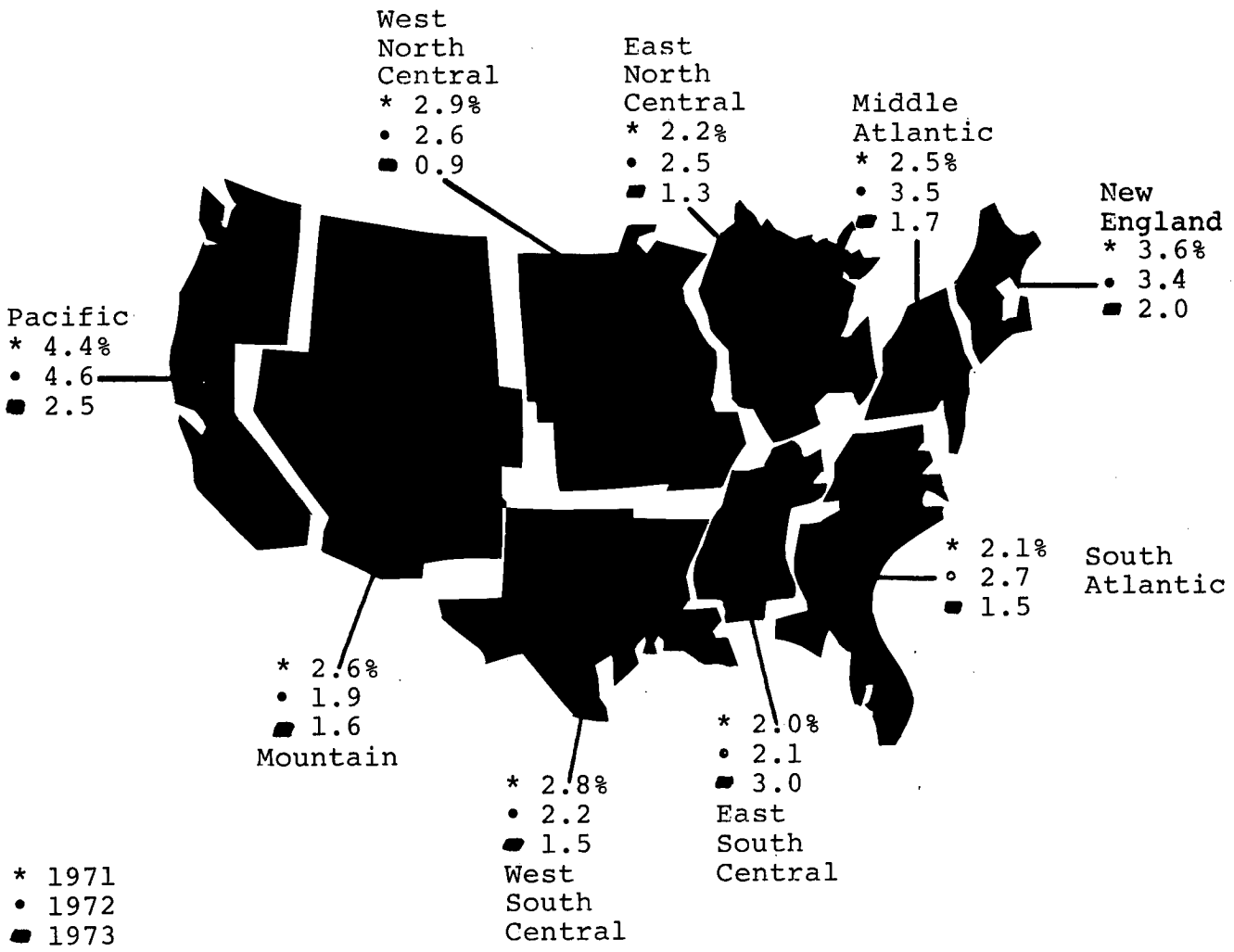
E-5 Unemployment By Employer Type

Employer	Industry	Education	Government	Nonprofit	Self Employed	Other	No Response
Total	7342	2724	1115	429	114	-	56
Unemployed	193	4	1	-	-	-	-
% 1973	2.6	<1	<1	<1	*	*	*
% 1972	3.1	2.0	1.9	5.0	2.7	6.4	14.5

* Insufficient data

Unemployment by Geographic Regions

1971, 1972, and 1973



D. Geographic Area

The general improvement in the unemployment rate is reflected in the state-by-state improvement. The West Coast, California in particular, continues to look bad as do Kentucky, Massachusetts, Virginia, and Tennessee.

E-6 Unemployed by State and Area

	Total	Unempl.	%
Pacific	1203		2.5
Washington	117	2	
Oregon	64	2	
California	997	26	
Alaska	5	0	
Hawaii	20	0	
Mountain	375		1.6
Montana	14	0	
Idaho	22	0	
Wyoming	21	0	
Nevada	19	0	
Utah	63	2	
Colorado	115	1	
Arizona	58	1	
New Mexico	63	2	
East North Central	2463		1.3
Wisconsin	193	2	
Michigan	483	7	
Illinois	749	7	
Indiana	259	3	
Ohio	779	14	
East South Central	429		3.0
Kentucky	93	5	
Tennessee	222	6	
Mississippi	35	0	
Alabama	79	2	
Middle Atlantic	3173		1.7
New York	1147	20	
Pennsylvania	911	18	
New Jersey	1115	16	
West North Central	674		0.9
North Dakota	19	0	
Minnesota	193	1	
South Dakota	10	0	
Iowa	90	3	
Nebraska	40	0	
Kansas	80	1	
Missouri	242	1	
West South Central	797		1.5
Oklahoma	142	1	
Arkansas	31	0	
Texas	492	10	
Louisiana	132	1	
South Atlantic	1799		1.5
Delaware	292	2	
Maryland	428	5	
West Virginia	91	1	
D.C.	49	0	
Virginia	272	7	
North Carolina	229	5	
South Carolina	118	1	
Georgia	129	3	
Florida	191	3	
New England	844		2.0
Maine	27	0	
New Hampshire	22	0	
Vermont	12	0	
Massachusetts	405	12	
Connecticut	318	5	
Rhode Island	60	0	

E. Specialty Field

Tables E-7a and E-7b examine employment status by specialty field. We present specialty field by degree to show the variance that occurs, e.g. biochemistry is Ph.D. dominated whereas analytical chemistry is B.S. dominated. We did not report the employment status group "retired not seeking employment" in the specialty grouping because of the high "no response" rate to the specialty question. Employment seems best for analytical chemists: 94.7% employed, 0.9% unemployed, and worst for inorganic chemists: 87.4% employed, 1.9% unemployed. While biochemists show low full-time employment, their unemployment is lower than the overall rate and they far exceed other specialties in postdoctoral and fellowship positions.

E-7a All Respondents by Field and Degree

	B.S.	M.S.	Ph.D.	Total
Analytical	969	447	513	1929
Biochemistry	184	174	1030	1388
Inorganic	147	143	431	721
Organic	488	398	1526	2412
Physical	116	152	882	1150
Polymer	350	196	456	1002
Engineering	553	319	299	1171
Other	566	400	602	1568
No response	114	98	144	356
Total	3487	2327	5883	11697

Among those retired but seeking employment, engineers seem to be more highly represented. Our survey results do not show whether this represents relatively high consulting activity or an employment problem. However, it can be generally demonstrated that chemical engineers have better employment prospects than chemists.

Among our respondents, there were 196 people in the information science/literature chemist area. In addition, 271 respondents indicated a non-chemical specialty. We believe patent attorneys and physicians make up a large portion of the latter group. The organic chemists constitute the largest specialty area.

E-7b Employment Status By Field*

	Unemployed	Part-Time	Sub Professional	Post-Doctoral/ Fellowship	Retired Seeking Work	Full-Time Employed
Analytical	17 (0.9)	15 (0.8)	23 (1.2)	24 (1.2)	8 (0.4)	1827 (94.7)
Biochemistry	17 (1.2)	26 (1.9)	15 (1.1)	111 (8.0)	4 (0.3)	1206 (86.9)
Inorganic	14 (1.9)	14 (1.9)	11 (1.5)	40 (5.5)	2 (0.3)	630 (87.4)
Organic	27 (1.1)	20 (0.8)	23 (1.0)	86 (3.6)	8 (0.3)	2225 (92.2)
Physical	22 (1.9)	23 (2.0)	21 (1.8)	44 (3.8)	6 (0.5)	1025 (89.1)
Polymer	16 (1.6)	7 (0.7)	7 (0.7)	9 (0.9)	3 (0.3)	953 (95.1)
Engineering	14 (1.2)	13 (1.1)	20 (1.7)	4 (0.3)	10 (0.9)	1086 (92.7)
Other	9 (0.6)	30 (1.9)	93 (5.9)	17 (1.1)	2 (0.1)	1401 (89.3)
No response	62 (17.4)	5 (1.4)	19 (5.3)	5 (1.4)	6 (1.7)	24 (6.7)
Total	198 (1.7)	153 (1.3)	232 (2.0)	340 (2.9)	49 (0.4)	10377 (88.7)

Numbers in parentheses indicate percent of total respondents in the particular field.
* Retired not seeking employment not included in this table.

F. Unemployment Frequency

Among those who reported unemployment frequency in the past four years, no non-degreed member indicated more than one unemployment episode. Our 3,487 Bachelor's degree holders reported 76 incidents of being unemployed twice and 20 of three times or more; 381 reported single occurrences of unemployment. For Master's degree holders (2,327 tallied) there are 40 individuals who were unemployed twice and eight who were unemployed three times or more; 267 had single episodes of unemployment. At the doctoral level (5,883 respondents) 50 persons reported being unemployed twice, while 11 were out of work three times or more; 474 had single occurrences of unemployment.

G. Other Findings

More than 80% of the respondents took their highest degree more than five years ago. About 50% of the membership hold the Ph.D.

III. 1973 Salary Data

During the 1960's, the broad availability of jobs and the regular pay gains achieved by chemists acted as a magnet to college students. The influx of students to the field was great; not just because of salaries, but because of career subsidies in the form of scholarships, fellowships, and postdoctoral positions. In 1969 the economy turned sour and the job market tightened. Unfortunately, we

are still experiencing high numbers of chemistry graduates. This is to be expected, since these people made career choices based on what was happening in 1968 or earlier.

In regard to salary, 1973 appears to be another healthy year for chemists. This should be viewed, however, in the light of the upward trend of inflation. The consumer price index has also moved upward strongly. In March 1971 it was 120, in March 1972 it was 124, and in March 1973 it was 130. Disposable personal income grew compared to the previous year as follows: 1st quarter 1971, 4.3%; 1st quarter 1972, 3.5%; 1st quarter 1973, 6.9%.

While recent economic setbacks hit chemists fairly hard, there were areas which remained strong through the drought. In general, our findings show that persons seeking high pay and security in chemistry should be advised to acquire the highest degree possible (perhaps avoid the M.S.) and attempt to move into management. Outside of management, it seems apparent that the best paying and most stable positions are with the Federal Government.

A. Salary Growth 1969 to 1973 by Degree and Employer

Table S-1 shows the median salary by employer type for chemists in the ACS from 1969 to the present. Salary gains for chemists in 1973 are the strongest since the 1960's.

Table S-1 Chemists' Median Salaries By Employer
Thousands of Dollars

	Bachelors					Masters					Doctors				
	1969	1970	1971	1972	1973	1969	1970	1971	1972	1973	1969	1970	1971	1972	1973
Employer															
Industry	13.0	14.6	15.0	15.7	16.9	14.4	15.8	16.4	17.2	18.0	18.0	19.0	20.0	21.0	22.0
Education	8.1	7.0	8.8	8.8	9.8	10.0	10.4	11.4	12.0	12.5	13.2	13.8	14.2	14.9	17.0
Government	13.2	14.5	16.0	16.9	17.9	14.2	16.0	17.0	17.8	19.5	17.8	19.0	20.7	21.9	23.0
Nonprofit	10.8	11.4	12.0	12.6	14.6	12.9	14.0	13.0	14.1	16.0	16.5	17.0	19.0	18.9	21.0
Selfemployed	20.0	18.0	17.5	15.5	16.0	18.0	17.0	18.0	15.8	17.5	18.6	23.7	21.0	20.0	24.5

Percent of respondents in each category were: Industry 60.6, Education 24.2, Government 10.6, Nonprofit 3.9, Selfemployed 0.7.

Among the self-employed the downward spiral has reversed. While it appears that the group in education is the least well paid, our unemployment statistics have shown this group has the fewest problems with regard to unemployment. Industrial chemists comprise 60% of the ACS membership and their salaries represent the typical chemist.

Our surveys have demonstrated that recently government employees fare the best as a group. This is probably due to the fact that government salary raises are tied to the cost of living, while the salaries of all other chemists are tied to supply/demand considerations. Government employees also have benefits available to no other group. A disadvantage in being a government employee would seem to be the fact that unlimited salary growth is prohibited by the strictly enforced grade/pay structure.

In the four-year period reviewed in table S-1, Bachelor's degree chemists working in industry have shown a spectacular 30% cumulative wage increase. However, during this period, unemployment for the Bachelor group was worse than any other group. Cumulative rises for Bachelors in academia and government are 21% and 36% respectively.

At the Masters level, salaries for industrial chemists rose 25% from 1969 to 1973. In education, it rose by the same percentage, while in government it rose 37%, the best gain posted by any group in the chart.

At the doctoral level, gains were not as spectacular, but they were still high -- 22% in industry, 20% in education, and 29% in government.

The lowest annual gain posted for government workers was the 4.7% rise for M.S.'s between 1971 and 1972.

Judging by table S-1 we would say that 1971-1972 was the worst period for chemists. This corresponds with data from our employment survey which shows an increase in unemployment rate from 2.7% to 3.0% during that period. This was followed by a decrease in 1973 to 1.7%.

Table S-2 examines the increase in chemists' salaries and income at all experience levels for the period 1972-1973. The strongest gain is among Doctors in the lowest pay bracket. It might be said that those at the low end of the pay scale are being brought up to par. The same may be said at the Bachelors level, but it is not true for Master's degree holders. The unemployment level for Masters recipients also seems to be high. When these two data are examined together, it appears that those at the Masters level are being squeezed more strongly than those with the B.S. or Ph.D.

Income, which in our definition represent salaries plus non-salaried compensation, improved more modestly. In our survey, 3,325 respondents indicated income in addition to salary. This represents 28% of the 11,780 responses tabulated for this question. Again, the

Table S-2 Salaries of Chemists By Percentiles All Experience Levels

Percentile	Bachelors 1972	Bachelors 1973	Bachelors %	Masters 1972	Masters 1973	Masters %	Doctors 1972	Doctors 1973	Doctors %
Lower 10%	$10.2	$11.0	8.8	$10.8	$11.2	3.7	$11.5	$13.3	15.7
Lower 25%	12.5	13.4	7.2	13.0	14.0	7.7	15.3	16.9	10.5
Median	15.6	16.8	7.7	16.3	17.5	7.4	19.2	20.5	6.8
Upper 25%	19.5	20.7	6.2	20.0	21.4	7.0	23.6	25.0	5.9
Upper 10%	24.0	26.0	8.3	24.5	26.0	6.1	29.0	31.0	6.7

Incomes of Chemists By Percentiles All Experience Levels

Lower 10%	$10.7	$11.1	3.7	$11.0	$11.8	7.3	$12.5	$14.2	13.9
Lower 25%	13.0	13.8	6.2	13.5	14.5	7.4	16.0	17.5	9.4
Median	16.0	17.0	6.3	17.0	18.0	5.9	20.0	21.3	6.5
Upper 25%	20.0	21.1	5.5	21.0	22.0	4.8	25.0	26.5	6.0
Upper 10%	25.0	27.1	8.4	26.0	27.5	5.8	31.0	33.0	6.5

1973 Salaries of Chemical Engineers All Experience Levels

	B.S.	M.S.	Ph.D.
Lower 10%	$14.0	$15.0	$17.0
Lower 25%	16.0	18.0	19.2
Median	20.2	22.0	23.1
Upper 25%	26.0	27.0	27.5
Upper 10%	31.5	35.0	35.0

1973 Incomes of Chemical Engineers All Experience Levels

	B.S.	M.S.	Ph.D.
Lower 10%	$14.2	$15.0	$18.1
Lower 25%	17.0	18.4	20.3
Median	21.0	22.5	24.5
Upper 25%	27.0	28.8	30.0
Upper 10%	33.4	36.0	38.0

greatest gain is shown for Doctors in the lower 10% of the income bracket. This is in agreement with the finding that the self-employed have fared the worst in the current recession and it also presages increased consulting opportunities.

1973 salaries and income for engineers are tabulated in S-2. They clearly illustrate that engineers are paid higher and have greater additional income than chemists.

Table S-3a Chemists' Salaries By Experience

	Years of Experience										
	1*	2-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40+	Overall
Lower 10%											
Bachelors	$ 6.4	$ 8.4	$10.0	$12.0	$12.0	$14.0	$14.7	$13.9	$14.0	$13.0	$11.0
Masters	7.4	9.5	10.0	10.5	13.2	14.0	13.2	13.4	14.0	11.0	11.2
Doctors	9.2	11.0	12.2	14.0	16.0	17.0	17.0	18.0	16.8	13.5	13.3
Lower 25%											
Bachelors	7.2	9.7	11.9	13.5	14.6	16.0	16.8	16.8	16.8	17.3	13.4
Masters	8.4	10.3	12.0	13.4	15.9	17.0	16.4	17.5	17.0	16.0	14.0
Doctors	10.8	12.5	14.4	16.5	19.2	21.0	20.0	21.7	20.5	18.0	16.9
Median											
Bachelors	8.3	11.0	13.3	15.5	17.2	18.4	20.0	20.5	20.0	22.0	16.8
Masters	9.6	12.0	14.2	16.0	18.1	20.0	20.0	21.0	21.3	20.5	17.5
Doctors	13.3	16.0	18.0	20.0	22.8	24.3	25.0	25.8	25.8	25.0	20.5
Upper 25%											
Bachelors	9.5	12.1	15.5	17.5	20.0	22.0	24.0	25.0	26.8	30.0	20.7
Masters	11.0	13.5	16.0	18.5	20.6	23.0	25.0	26.0	26.0	27.0	21.4
Doctors	15.8	18.0	20.5	23.0	25.8	29.0	30.0	32.0	32.0	30.0	25.0
Upper 10%											
Bachelors	10.2	13.7	17.3	20.0	24.0	26.0	28.0	30.5	33.0	35.0	26.0
Masters	12.0	15.2	18.0	21.9	24.0	26.1	28.2	32.5	33.0	35.0	26.0
Doctors	16.5	19.6	22.7	26.5	30.0	35.0	35.0	36.6	38.5	38.5	31.0

* From the 1972 Starting Salary Survey (the 1973 Comprehensive Salary Survey had insufficient data in this category).

B. Experience

Income and salaries of chemists arrayed by experience appear in tables S-3a and S-3b. In order to provide complete information for those who use ACS salary surveys as determinants in salary offers to prospective employees, we replaced the column relating salaries of chemists with one year or less experience from this survey with the results obtained for this group in our Starting Salary Survey carried out in the summer of 1972. Lacking this, our response rate would have been too low to fill all data cells. Increments in this 1972 data might be as high as 7% in 1973.

Table S-3b Chemists' Incomes By Experience

	Years of Experience									
	1*	2-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40+	Overall
Lower 10%											
Bachelors	na	$ 8.5	$10.7	$12.0	$12.2	$14.0	$15.0	$14.0	$14.0	$13.0	$11.1
Masters	na	9.5	10.4	11.3	13.8	14.5	13.5	13.5	14.7	11.0	11.8
Doctors	na	11.5	13.0	15.0	17.0	18.0	17.7	19.0	17.4	14.1	14.2
Lower 10%											
Bachelors	na	9.8	12.0	13.7	15.0	16.0	17.0	17.0	16.8	19.2	13.8
Masters	na	10.8	12.5	13.6	16.0	17.1	16.7	18.0	17.5	17.8	14.5
Doctors	na	13.7	15.1	18.0	20.0	21.7	22.0	22.6	22.0	19.2	17.5
Median											
Bachelors	$ 8.5	11.0	13.4	16.0	17.7	18.6	20.4	21.0	20.4	23.5	17.0
Masters	10.0	12.0	14.6	16.8	19.0	20.0	21.0	22.0	22.0	21.2	18.0
Doctors	13.0	16.5	18.5	20.8	23.6	25.5	26.6	27.0	27.5	27.0	21.3
Upper 25%											
Bachelors	na	12.5	15.8	18.0	20.8	22.1	24.6	27.0	27.5	31.0	21.1
Masters	na	14.1	16.1	19.0	21.0	24.0	25.0	27.0	28.8	29.0	22.0
Doctors	na.	18.3	21.0	24.0	27.0	30.0	32.0	33.0	35.0	32.3	26.5
Upper 10%											
Bachelors	na	14.0	18.0	21.0	25.3	27.0	30.0	33.5	33.5	35.0	27.1
Masters	na	16.0	18.5	22.5	25.0	28.0	30.0	34.0	33.5	35.0	27.5
Doctors	na	20.0	23.4	28.0	32.0	37.0	40.0	40.0	40.0	50.0	33.0

*Responses were insufficient in this category

These wage experience charts are similar to those computed by other groups. Typically, the personnel officer graphs year of B.S. degree against salary. That is, years of experience is considered to be equal to years since the B.S. was taken. In ACS surveys we have not used the year of B.S. to determine years of experience. We find that when we compare the two methods there is a variance of about three years. Thus, if the employer used the B.S. year methodology in our table S-3a, one might fall into the experience category on his scale that is the next highest category on our scale. In comparing salary then, one should look to the cells next highest in experience. If one is out of line here, he is definitely below par on the pay scale (i.e. our 2-4 years of experience may equal your employers 5-9 years experience).

To be noted in these tables is the characteristic growth of salary with experience to a maximum previous to retirement and then a decrease. Noteworthy also, is the closing of the gap between Bachelors and Doctors in the upper pay/upper experience levels. Salary at the highest level seems to be less degree related than is the case in the early career years. With regard to salary versus income, previous studies have shown that those engaged in teaching garner the greatest percentage gain in income, while those in research and development do least well in this respect. That is, a teacher should expect to add to his salary an additional 9% in outside income, while an R&D man should expect only about a 3% increase in income through this channel.

Table S-4 Chemists' Salaries by Sex 1973

Years	B.S. Men	B.S. Women	M.S. Men	M.S. Women	Ph.D. Men	Ph.D. Women	Distribution Men	Distribution Women
<1	$ 8.3*	$ 9.0*	$10.5*	$10.0*	$12.6*	$ 9.5*	87.2%	12.8%
2-4	11.0	10.1	12.5	10.1	16.2	12.7*	89.7	10.3
5-9	13.6	11.7	14.6	11.6	18.0	14.0	91.1	8.9
10-14	15.7	13.0	16.6	13.5	20.0	14.4	91.7	8.3
15-19	17.8	13.1*	18.5	14.2	23.0	17.6	92.3	7.7
20-24	18.5	14.8	20.0	16.9	24.8	16.6	93.0	7.0
25-29	20.4	16.0	21.0	14.8	25.1	17.5*	93.0	7.0
30-34	20.6	15.0	21.6	13.0*	26.0	19.2	93.3	6.7
35-39	20.0	14.4	21.7	19.5*	26.0	19.3	93.5	6.5
40+	24.8	13.0	21.4	13.2	25.0	20.8*	93.5	6.5
Overall	17.0	12.6	18.0	13.0	20.9	15.3	93.5	6.5

* Response rate too low to be statistically valid (less than 25 responses).

C. Gender

There has been a great deal of publicity about equal pay for women. Within the scientific disciplines, there seems to be a definite concern for fair employment practices, yet our survey data show no equalization taking place except possibly at the B.S. level with no experience. In addition to the salary/experience/degree data by gender in table S-4, the Manpower Studies Office tabulated unemployment by gender and degree. Besides being possibly underpaid, the female is more apt to be unemployed. In fact, and contrary to the canard that affirmative action programs are harming employment opportunities for the majority, non-minority males are better paid and face less unemployment than any similar grouping.

While our study shows that women cluster in the low paying areas -- 37% in teaching versus 10% of males in teaching, 5.4% of females in management versus 18.5% of males -- there is an indication that more females are moving from teaching to R&D, while the reverse is true for men. Furthermore, women may be moving from biochemistry and analytical chemistry into the catchall "other" category.

For those employers who use year of Bachelor's degree to determine the proper wage/experience curve, there should be no reason to pay women at a different rate than men, especially where the women have been on the payroll for more than two years.

D. Employer

Undoubtedly, the employer type determines, to a large extent, the economic well being of the chemist. Most noticeably, educational salaries are low, while industrial salaries set the norm and government salaries continue strong. Historical data show that the self-employed category (year 1969 and earlier) commanded high pay. It may well be that the turndown from 1969 through 1972 has been reversed and remuneration in this area has started to climb.

Since industrial chemists form the larger part of the chemists group, we break these out in table S-5. What is true for all chemists is true for this group. Indeed, the industrial chemist group by its size determines the norm for the survey. Our employment survey statistics show the same is true with regard to employment status. That is, unemployment above 1% only occurs among industrial chemists in 1973 and this sets the unacceptable overall rate of 1.7%.

Table S-5 Industrial Chemists' Salaries By Percentiles And Experience

Percentile Rank	1 year or less	Years of Experience 2-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40+	Overall
				Thousands of Dollars							
Lower 10%											
Bachelors	na	$ 9.5	$11.0	$12.0	$12.2	$14.0	$14.9	$14.0	$14.6	$13.0	$11.6
Masters	na	10.2	12.5	13.5	14.4	15.0	15.0	15.6	15.0	14.0	13.0
Doctors	na	15.0	17.0	18.3	19.2	20.0	19.2	20.0	18.0	12.0*	17.3
Lower 25%											
Bachelors	na	10.3	12.0	13.5	15.0	16.0	17.0	16.6	17.2	17.5	13.9
Masters	na	11.3	13.5	15.0	16.8	17.5	17.3	18.5	17.5	18.0	15.0
Doctors	na	16.7	18.4	20.0	21.1	22.0	22.6	23.3	22.0	22.0*	19.2
Median											
Bachelors	$ 8.5	11.2	13.5	15.3	17.0	18.4	20.0	20.0	20.0	22.0	17.0
Masters	12.0	12.8	14.8	17.0	19.0	20.1	20.8	22.0	22.0	21.5	18.2
Doctors	15.6	18.0	20.0	22.0	24.0	25.3	26.0	27.0	26.4	30.0*	22.1
Upper 25%											
Bachelors	na	12.5	15.5	17.2	20.0	21.6	24.0	25.0	27.0	30.0	20.8
Masters	na	14.0	16.5	19.0	21.5	24.0	25.0	27.0	27.4	26.5	22.2
Doctors	na	19.0	22.0	25.0	26.4	30.0	31.2	33.0	34.6	40.0*	26.0
Upper 10%											
Bachelors	na	13.9	17.5	20.0	25.9	26.0	28.0	32.0	33.0	34.0	26.5
Masters	na	15.5	18.0	23.0	25.0	26.4	30.0	33.0	33.0	35.0	26.5
Doctors	na	20.0	24.0	28.0	31.0	36.0	37.0	40.6	41.0	50.0*	32.5

na=not available
* Less than 25 responses in this category

E. Work Activity

Table S-6 relates work activity to years of experience and degree. This table demonstrates that management is the best place to be if one is primarily concerned with salary. In addition, managers have experienced less unemployment during the recent recession. It is also interesting to examine the various tracks with regard to salary growth. Obviously, the management group grows faster and achieves higher levels. The highest salary level for those in teaching (21.0) is achieved by the management group after only 5-9 years and in the R&D group after 10 years. While some companies may have parallel lines of advancement, one in management, the other in R&D, our survey clearly demonstrates that after 10 years experience salary differs substantially between these two groups so it must be presumed that equity is not sustained if it indeed exists at all.

Table S-6 Chemists' Salaries By Work Activity

	Years of Experience										
	1 year or less	2-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40+	Overall
	Thousands of Dollars										
Management											
Bachelors	$11.5*	$10.4*	$14.4	$18.1	$21.0	$22.0	$24.0	$24.2	$28.3	$26.0*	$21.8
Masters	15.6*	14.5*	16.5*	18.7	22.0	21.9	25.0	28.0	25.5	29.3*	23.0
Doctors	18.0*	17.3*	21.5	25.4	26.0	28.0	30.0	32.4	34.0	30.0*	27.2
Research & Development											
Bachelors	9.5*	11.2	13.3	15.2	16.9	18.0	19.5	20.3	19.6	20.0*	16.2
Masters	12.0*	12.4	14.7	16.6	18.1	20.0	20.8	21.0	21.3	20.0*	17.5
Doctors	13.5*	17.6	19.6	21.5	23.0	24.3	25.0	25.9	25.4	29.4*	21.3
Teaching											
Bachelors	6.2*	8.2*	9.8*	11.7*	12.8*	15.0*	15.0*	17.3*	13.6*	13.0*	9.6
Masters	4.5*	10.0*	11.0	12.6	15.4	13.8	14.4*	15.0*	17.0*	14.5*	12.6
Doctors	11.1*	12.0	14.0	16.3	18.5	21.0	21.8	21.0	20.9	19.5	16.5
Marketing & Production											
Bachelors	8.5*	11.1	12.8	15.3	16.0	17.4	18.8	17.6	18.0	20.0*	16.0
Masters	11.0*	12.0	14.8	16.5	18.8	19.4	18.0*	20.5	19.4*	17.8*	17.2
Doctors	9.5*	16.3*	19.0	19.5*	21.3	23.1	23.0*	25.0*	24.0*	22.0*	20.0
Other											
Bachelors	6.7*	4.3*	6.0*	10.5*	30.0*	18.4*	32.0*	19.6*	na*	na*	15.1*
Masters	10.0*	12.0*	9.5*	na*	na*	20.3*	na*	10.6*	na*	na*	10.0*
Doctors	na*	30.0*	13.5*	12.7*	na*	22.0*	na*	na*	na*	na*	14.0*

na=not available
* Less than 25 responses in this category

Table S-7 Chemists' Salaries By Field

	Years of Experience										
	1 year or less	2-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40+	Overall
	Thousands of Dollars										
Analytical Chemistry											
Bachelors	$ 9.0*	$10.8	$13.2	$15.0	$15.7	$17.5	$18.3	$19.0	$19.0	$24.8*	$15.6
Masters	8.3*	11.6	14.8	16.8	17.7	18.7	19.4	20.0	21.3*	17.4*	17.0
Doctors	15.6*	15.3	18.0	20.7	20.4	23.0	23.6	22.8	22.0*	22.0*	19.5
Biochemistry											
Bachelors	9.5*	10.0	11.6	15.9	15.0*	18.4	20.2	21.9*	26.0*	25.5*	16.0
Masters	9.5*	12.0	13.1	15.5	16.8	19.5	18.4*	23.0*	18.8*	21.0*	15.5
Doctors	11.0*	15.3	18.1	20.7	23.0	26.0	25.9	26.0	27.0	30.0*	21.0
Inorganic Chemistry	7.9*	9.6	12.8	14.6	17.5	17.5*	21.0	21.0	19.7	13.0*	16.2
Masters	na*	10.0	12.4	14.3	17.0	17.8	21.0*	17.5	21.7*	21.5*	16.0
Doctors	11.1*	14.0	14.9	16.1	20.9	22.5	24.3*	24.4*	19.7*	16.5*	17.0
Organic Chemistry											
Bachelors	9.7*	11.8	13.4	15.1	18.7	20.0	19.5	21.0	22.0	18.8*	17.0
Masters	11.0*	12.4	14.0	16.0	19.0	20.1	19.8	24.0	20.0*	20.0*	18.0
Doctors	13.5*	16.7	18.4	19.5	23.9	24.4	25.2	26.0	26.0	19.0*	20.3
Physical Chemistry											
Bachelors	na*	11.4	13.0	15.8	20.0	18.6	18.2*	21.0*	24.0*	25.5*	17.0
Masters	12.0*	12.0	13.0	16.6	17.3	19.3	24.0	24.0	25.3*	19.0*	18.0
Doctors	13.1*	15.3	17.2	20.0	22.5	24.1	24.0	25.6	27.0	23.9*	20.4
Polymer Chemistry											
Bachelors	na*	11.5	13.7	16.2	18.0	19.0	21.0	20.0	19.0*	30.0*	18.0
Masters	na*	14.2*	16.3	17.9	18.9	21.1	19.0*	21.5*	22.9*	na*	18.6
Doctors	na*	18.5	20.0	22.0	24.0	24.0	26.3	26.9	25.1*	30.0*	22.4
Other Specialties											
Bachelors	8.0*	11.0*	13.8	16.1	17.9	18.5	21.8	22.0	20.4	25.5*	18.0
Masters	12.8*	12.2	14.1	15.4	19.3	20.0	19.7	21.5	21.9	23.5*	18.0
Doctors	na*	14.7	16.5	19.6	21.9	25.0	27.2	27.2	27.0	28.0*	22.0

na=not available
* Less than 25 responses in this category

F. Field

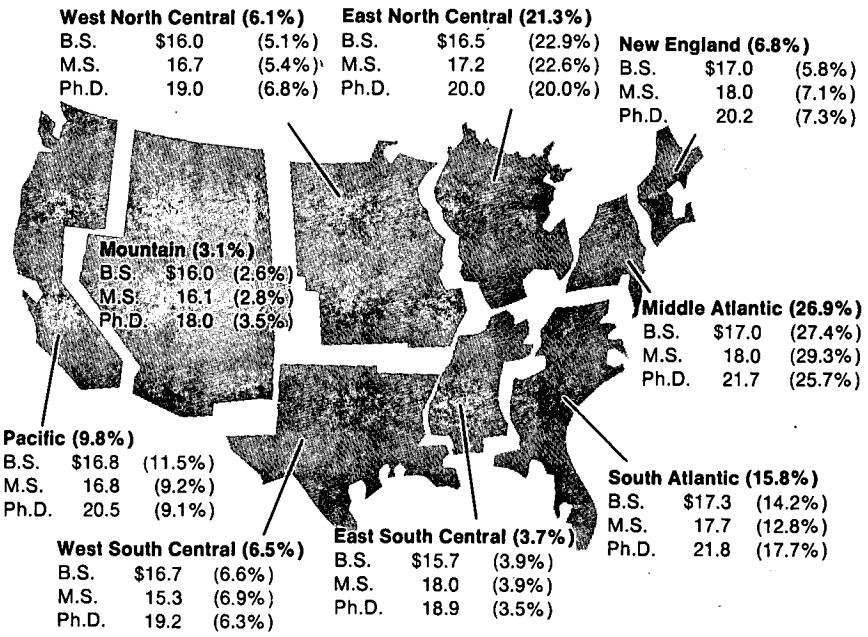
By Field we mean the traditional broad specialty area in which chemists work (table S-7). Most probably a good portion of our respondents fall into more than one category. For the purposes of this analysis our editing routine established one specialty per respondent. As was true in 1972, polymer chemists, as a group, show the highest salaries. Last year physical chemists were clearly the next best paid, but this year, in the aggregate, there is little difference between the physical chemist and those specializing in organic chemistry. In addition, the organic group represents about twice as many respondents in each degree category. For organic and polymer chemists the unemployment rate was worse than that for analytical chemists. Physical chemists are preponderantly Ph.D.'s, while analytical chemists are mostly Bachelors. For polymer chemists the degree distribution is 35% B.S., 20% M.S., 45% Ph.D.'s, very close to the degree distribution of all ACS members.

Once again, this year Ph.D. biochemists are doing well. With increasing emphasis on health care, this is probably a strong growth area. Among our respondents we also have several physicians and lawyers; these people usually exceed the median salary for chemistry degree holders.

G. Geography

Chemists' overall median salaries are the best in the South Atlantic states. Our grouping by geographic area may not best describe employment for chemists since it is borrowed from Census descriptions of the populace. Thus, it might be more proper to group Delaware, Maryland and Washington D.C. with the Middle Atlantic States (Pennsylvania, New York and New Jersey), than with the Southern States (Virginia and southward on the Atlantic seaboard). We might also more realistically compare Massachusetts and Connecticut with the Middle Atlantic States, than with the rest of New England. (Areas of high industrial employment should be compared, whereas states like Vermont, North Dakota, Nevada, Arizona should most likely be grouped as non-industrial for salary level comparisons. Where the preponderance of chemists is in industrial employment, salaries should be higher; where the preponderance of chemists is in non-industrial employment (usually education) other comparisons should be made.

Table S-8



How to read: Using New England as an example, 6.8% of the responding chemists work in this U.S. census area; 5.8% of all B.S. chemists live there and their median annual salary in 1973 is $17,000.

Note: All salaries in thousands of dollars.

If one is using this information to determine the best geographical area in which to find employment as a chemist, he should include in his calculation the risk of unemployment. Thus, while the Pacific coast shows high salaries, California has been significantly higher in unemployment that most other states. New Jersey, which was high in unemployment in 1972, has shown a remarkable recovery and most other states seem to have moved back to more acceptable levels of unemployment. This year Kentucky and Tennessee exhibit a relatively high unemployment rate. We have been unable to account for this by identifying particular mass layoffs, yet our statistics do indicate a worsening trend. By and large, most states have moved down in unemployment at about the national rate, just as they moved up on a state by state basis when things were generally bad. Stability existed in those states where chemists were for the most part in academia.

Table S-9 Salary Levels By Degree And Minority Group
(Dollars in Thousands)

	≤ $5*	$5-14.9	$15-24.9	$25-34.9	$35	Returns	% of Degree Level
Bachelor's (29.6%)**							
Non minority	239	997	1640	394	103	3373	96.7
Black	1	18	16	3	-	38	1.1
American Indian	-	2	1	-	-	3	0.1
Oriental	3	30	24	1	-	58	1.7
Spanish	2	9	5	-	-	16	0.5
					Total	3488	
Master's (19.8%)							
Non minority	210	567	1088	274	77	2216	95.1
Black	2	6	17	4	-	29	1.2
American Indian	-	1	1	-	-	2	0.1
Oriental	6	28	27	2	1	64	2.7
Spanish	-	7	10	1	-	18	0.7
					Total	2329	
Doctorate's (49.9%)							
Non minority	305	1017	2808	1121	299	5550	94.2
Black	1	9	33	8	1	52	0.9
American Indian	-	1	5	5	-	11	0.2
Oriental	8	77	138	21	1	245	4.2
Spanish	2	12	13	3	2	32	0.5
					Total	5890	
Overall							% of Total
Non minority	754	2581	5536	1789	479	11139	94.5
Black	4	33	66	15	1	119	1.0
American Indian	-	4	7	5	-	16	0.1
Oriental	17	135	189	24	2	367	3.1
Spanish	4	28	28	4	2	66	0.6
					Not tabulated	85***	
					Grand Total	11792	

* Includes those who did not report salary.
** Percent of minority respondents at this degree level.
*** No response to degree, no response to ethnic code 11(0.09%);
Less than B.S. Degree 72(0.16%) one of whom was Oriental;
Degree code error non minority group 2(0.00%);
Grand Total 11,792. Percentages are rounded and don't necessarily add to 100.

H. Other Findings

This year in our comprehensive survey we asked for data on race/ethnic group. Preliminary results are not startling. These figures must be examined with caution for several reasons. Chief among these are: (1) membership in ACS and, (2) foreigners taking advanced training in the U.S.

Studies of Census data on college graduates by race (correlated with chemistry degrees as a percentage of all degrees) provide a rough estimate of the numbers of each ethnic group which become chemists. About 50% of chemists in the U.S. become members of the ACS, while virtually all Ph.D.'s join the ACS. Thus, while extrapolation of data on Ph.D.'s based on ACS membership fractions is accurate, at the lower degree levels this is not true. In addition, at the lower degree levels, contact with the ACS is more likely to occur in connection with an ACS accredited chemistry department or an ACS student affiliate group. Probably 1/2 or more of minority group members in the U.S. who pursued a baccalaureate course in chemistry did so at a non-ACS-accredited school. Thus, unless they took graduate training their exposure to the ACS was limited.

For Orientals, unless one presumes a violent passion on the part of the native born for chemistry, we cannot justify the 3.1% of chemists who are Oriental. The Oriental chemist group is made up at the Bachelors level of probably 50% foreign nationals, at the Masters level it appears to be about 2/3 foreigners, and at the Doctoral level probably 4/5 foreigners. (In physics about 1/9 of Oriental graduate students are Americans.) Census statistics show .77% of the native population to be of Chinese, Japanese, Filipino, Korean or Hawaiian origin.

Overall, the picture for 1972 is one of general improvement with above average wage increases. While unemployment is down, it has not reached acceptable levels in all areas, so there remains some risk in pursuing a career in chemistry. The older chemist who, by happenstance, suffers unemployment will continue to experience difficulty in gaining a new position at an equivalent level. To this writer the risks seem worth the long term rewards.

IV. Minorities and Women

There has been an increasing interest in the numbers of minority group members among chemists. Particular emphasis has been placed on Blacks, American Indians, Orientals and Hispanics (a catch-all category for the various Spanish derivative Americans). Affirmative action programs also emphasize the hiring of women.

The Manpower Studies Office searched the available data sources so as to be able to respond to the increasing number of inquiries

about minority and female chemists. Hard data, such as number at each degree level by race and gender, is not available. Only recently has it become fashionable (and legal) to include descriptors of ethnic group, religion, or race in personnel files.

It was felt that the number of each of the above minorities in chemistry was not in the same proportion as those minorities in the general populace. In particular, Blacks, who form the bulk of the non-white minority in the U.S.A., were thought to occur in much lower numbers among chemistry populations than among the public-at-large.

Whereas 11-12% of the American population is Black, enrollments in colleges and universities by Blacks was 7% or less and has only recently climbed as high as 9%. Assuming 200,000 chemists and chemical engineers in the U.S.A. (46,000 of whom are Ph.D.'s) and a population of 210,000,000, a rough factor for chemical professionals would be one per 1,000 persons. (Using BLS estimates of 187,000 chemists and chemical engineers in a population of 210,000,000, the rate per thousand would be 0.9.) We would then say that a high estimate for chemists and chemical engineers among the general population would be one in 1,000 and a high estimate of Ph.D.'s would be 25% of that figure. (ACS membership is high on the Ph.D.'s side.) Using this argument for Blacks, we would expect 22,600 Black chemists and 5,650 Ph.D.'s. We have examined in closer detail the production of chemists within the Negro race and we have discovered our 1 in 1,000 conversion factor misses the mark. There are, at most, 8,200 Negro chemists in a population of 22,600,000, about 4 per 10,000 persons.

Cultural aspects must be considered to clarify this disparity. More Negro women graduate from college than Negro men; chemistry degrees are gender related. Unfortunately, a good share of Negroes who go on to higher education enter two year colleges. The presumption is that these people most likely will not develop into chemists in accordance with ACS's definiton of "chemists." Other studies show that around 50% of Negroes in four year colleges are in traditionally "Black" schools.

The Manpower Studies Office examined data from 89 traditionally Negro schools for the decade of the 60's. We attempted to develop factors which would show the portion of Negro college graduates who take degrees in chemistry.

This study showed that 1.8% of B.S. degrees to Negroes are in chemistry. Furthermore, this factor approximates that found in the "all races" category (1.7%). (To develop the factor for Negroes, we had to presume all graduates of traditionally Negro schools are Negro.)

Using this factor and 1970 Census figures for the number of Negros who had four or more years of college, we calculated the approximate number of Negro college graduates who took B.S. degrees in chemistry.

About 50% of those who take a B.S. in chemistry remain in the field. So that (through 1970) of 7,000 B.S.'s in chemistry awarded to Negroes, no more than 3,500 continue active in the field. Adding 1,000 degrees for 1970-1972, we have 8,000 total and 4,000 active respectively. There are about 200,000 chemists and chemical engineers in the U.S.A. today. Thus, about 2.0% of chemists are Negroes. About one out of two chemists join the ACS. If the same is true for Negroes, our survey would show 2.0% of all chemists are Negro. (See Appendix 4 which shows 1% of ACS members are Black.)

Our result is not surprising in view of the high educational level of ACS members (more than 60% have the M.S. or better). The educated Negro has not characteristically sought employment in industry.

If we use these same figures and reasoning, admitting a Negro bias against joining ACS, we would estimate that there are about 830 Ph.D. Negro chemists in the U.S.A., out of a total of 46,000 Ph.D.'s in chemistry. This is about quadruple the number cited in the literature Jay, Negroes in Science. However, other studies indicate that almost all Ph.D.'s remain in chemistry and are members of ACS. It would be proper then to say that the range of Negro chemist Ph.D.'s is 368-460 (414 average), where the low is about 1 1/2 times the value given by Jay, and the high is less than double that value. Thus, we have less than one Negro Ph.D. for every three teaching departments in chemistry. Our data seems to show that Negroes pursue the Ph.D. at a lower rate than the general populace -- less than 1 in 19, as opposed to one in four.

Using the same arguments we used to obtain the number of Negro chemists from 1970 Census data (those with four or more years of college), we find there are about 4,300 Spanish speaking chemists. The number of Ph.D.'s should be less than 1 in 19 or 226. (Median school years is the same in the Spanish group as it is for Negroes.) If 50% of Spanish-American chemists remain in the field, 2,150 or 1.1% are Spanish. The available literature, Spanish Surnamed and Native Americans in Science and Engineering, by J. Martinez, indicates 61 Ph.D.'s in chemistry. Appendix 4 indicates 230 with a range of 184 to 276. Census figures for the Spanish group, by the way, show that while 68 thousand males indicate four years of college, 82 thousand indicate five or more years. Our conclusion is that ACS membership is not representative with regard to chemists of Spanish origin.

The numbers of other minority groups are also open to question. With regard to American Indians, the number of respondents

is too low to draw firm conclusions. Census figures would put the number of Amerind chemists at less than 790. If 1 in 19 take the Ph.D., as is the case for Negroes, there would be 42 Ph.D.'s. Our data show 92 as average with a range of 46 to 138.

We feel uncertain about the number and percentages of Orientals since our survey does not clarify the citizenship of the individual. Census data would lead us to expect a much lower representation (about 2,400 chemists of whom 600 are Ph.D.'s). There is no noticeable proclivity for American Orientals to become chemists. (The American Institute of Physics data indicate about 1 in 9 Oriental physics graduate students in American schools are American.)

Women receive about 20% of the Bachelor's degrees awarded in chemistry. They represent about 7% of the working ACS membership. The percent of Ph.D.'s going to women has been slowly rising in the last two decades and can be put at 8% currently. Of all Ph.D.'s about 4.6% are held by women (about 2,200). Since 1960 there have been about 1,500 female Ph.D.'s. The flow of females into secondary education is high. This group is not well represented within ACS, thus, our surveys might not cover well those women who took degrees in chemistry and are working full-time as chemistry teachers.

In summary, there are about 46,000 Ph.D.'s: 2,200 are women, 45 are American Indian, 230 are Spanish-American, 415 are Negro-American, 600 are Oriental-American.

For sample sizes, such as those in our survey (10,000) which represents more than 1/10 of our universe, even our areas of low response have strong statistical validity. Where we report less than 1% of our respondents fitting a category (i.e. 0.1-0.9%) at the 99% confidence level, the range would be within 0.1% of the value we report.

We must, however, recognize that ACS membership is biased and educational attainment may be biased, so that in interpreting these results we cannot be dogmatic. Note however, that almost all chemistry Ph.D.'s have contact with and usually join the ACS. This is not true in cases where the M.S. or B.S. is the highest degree. Thus, in extrapolating the number of Ph.D.'s in a category, it would be legitimate to use the 46,000 total Ph.D.'s in chemistry awarded in the past 40 years. It would not be fair to extrapolate all categories obtained in ACS surveys to the 200,000 American chemists at all degree levels.

A P P E N D I C E S

Appendix 1

AMERICAN CHEMICAL SOCIETY
1973 Comprehensive Salary and Employment Status Survey

1 A. Sex: (1)___Male (2)___Female

2-3 B. Year of birth_____

4 C. Highest degree earned: (1)___B.S. (2)___M.S. (3)___Ph.D. (4)___Less than B.S.

5-6 D. Year of highest degree:_____

7-8 E. Year of bachelors degree:_____

9-10 F. State of residence_____

11-15 G. Zip Code_____

H. Minority group data:

16 Are you a member of any of the minority groups listed to the right?

(1)___Yes (2)___No

17 If yes, please check those which apply to you:
(1)___Black/Negro
(2)___American Indian
(3)___Oriental
(4)___Spanish Surnamed American (defined by EEO to include persons of Mexican, Puerto Rican, Cuban, or Spanish origin)

18 I. Current Employment Status:

(1)___Employed full-time in my field
(2)___Unemployed and seeking employment
(3)___Temporarily or part-time employed in my field
(4)___Academic, postdoctoral or other fellowship
(5)___Employed outside my field or subprofessionally
(6)___Retired, seeking employment
(7)___Retired, not seeking employment

19 J. If industrially employed check employer field (Industry):

(a)___Aerospace/aeronautics
(b)___Agricultural chemicals
(c)___Automotive
(d)___Cosmetics, detergents, toiletries
(e)___Electronics, electrical equipment
(f)___Engineering design/construction
(g)___Environmental services
(h)___Food products and processing
(i)___Glass, ceramics, cement, clay products
(j)___Industrial chemicals and intermediates
(k)___Laboratory equipment, instruments, supplies
(l)___Metals
(m)___Nuclear energy and allied fields
(n)___Paints, coatings, dyes, inks, pigments
(o)___Paper
(p)___Petroleum
(q)___Pharmaceutical
(r)___Photographic, copying
(s)___Plastics, synthetic resins
(t)___Rubber
(u)___Textiles, synthetic fibers
(v)___Other (specify)_____

20 K. If non-industrially employed check employment area:

(1)___College or university
(2)___High school or other school
(3)___Federal government
(4)___State or local government
(5)___Self employed
(6)___Hospital, independent laboratory
(7)___Non-profit organization
(8)___Other (specify)_____

21 L. Primary work activity:

(1)___Research/development
(2)___Management/administration
(3)___Marketing/technical services/sales
(4)___Teaching/academic/research
(5)___Student/postdoctoral
(6)___Production/quality control
(7)___Other (specify)_____

22 M. Chemical specialty:

(1)___Analytical
(2)___Inorganic
(3)___Organic
(4)___Physical
(5)___Biochemistry/clinical/medicinal
(6)___Polymer
(7)___Chemical engineering
(8)___Literature, information science
(9)___Other chemical specialty
(0)___Other non-chemical specialty

N. Income (nearest $100): 23-27 Basic annual salary_____ 28-32 Total professional income_____

33-34 O. Years of professional work experience including postdoctoral study_____

35 P. Have you been unemployed at any time since January 1, 1969? (1)___Yes (2)___No

36 Q. How many times have you been unemployed since January 1, 1969?_____

37 R. Have you voluntarily changed employers since January 1, 1969? (1)___Yes (2)___No

(Your answer to the following questions will be helpful to our future planning.)

S. Have there been layoffs, job reductions, forced retirements and similar cutbacks among chemists and/or chemical engineers at your present or most recent work location in the following years?

38 1969: (1)___Yes (2)___No
39 1970: (1)___Yes (2)___No
40 1971: (1)___Yes (2)___No
41 1972: (1)___Yes (2)___No

42 T. How do you view the job market outlook for chemists and chemical engineers in 1973-1976?
(1)___Excellent (2)___Good (3)___Poor (4)___No opinion

43 U. Are your ACS dues paid by your employer? (1)___Yes (2)___No

44 V. Is your employer an ACS Corporation Associate? (1)___Yes (2)___No (3)___Do not know

W. Have you used or are you using any of the many services of the Employment Aids Office in seeking a position?

45 In the past: (1)___Yes (2)___No
46 Currently: (1)___Yes (2)___No

47 X. Would you be interested in an unemployment insurance program provided through an insurance company to supplement your state unemployment compensation program? (1)___Yes (2)___No

Y. For such an insurance program, do the following seem adequate and reasonable?

48 Benefits from $70 to $200 a week? (1)___Yes (2)___No
49 A premium scale of $7 to $15 a month? (1)___Yes (2)___No
50 A benefit period of up to 26 weeks? (1)___Yes (2)___No

(We would appreciate having your opinions, comments, or suggestions on the reverse side of this page. Survey responses will be treated anonymously for reporting purposes.)

Appendix 2 Minorities in U.S.A.

The following tabulations are based on the 1970 Census:

		%
Total Population	203,211,926	
White	177,748,975	87.47
Negro	22,580,289	11.11
Other Races	2,882,662	1.42

Included in Other Races are:

American Indians	792,730	0.39%
Japanese, Chinese, Filipino, Hawaiian, Korean	1,573,099	0.77
Total	2,365,829	

55% of "other races" are Orientals, 27% of "other races" are American Indians.

As an identifiable ethnic group we have:

Spanish-Americans	9,294,509	4.57%

By Occupation in the category "Professional and Technical Workers" we have:

	Total	% White	% Negro	% Other	% Spanish
Engineers, technical	1,207,509	97.1	1.1	1.9	2.1
Physicians, dentists	538,746	94.8	2.1	3.1	2.7
Medical, health worker	1,204,822	89.7	8.3	2.0	2.5
Teacher, elementary/secondary	2,540,420	90.7	8.4	0.8	1.9
Technicians, except health	958,645	95.2	3.2	1.6	3.2
Other professional workers	4,898,672	93.6	4.9	1.6	2.3

By Occupation in the category "non-farm Manager and Administrators Salaried" we have:

Manufacturing	958,844	98.6	1.0	0.4	1.5
Other Industries	3,034,454	96.0	3.1	0.9	2.2

Median school years achieved by all census respondents age 25 or over 12.08%; by Negroes 9.75%; by Spanish 9.63%. Percent of those 25 and over who are high school graduates is 52.34 for all respondents; 31.44 for Negroes and 36.00 for Spanish.

Appendix 2, continued

Occupation by Industry [PC(2)-7C]

Negro	Male	Female	
Chemical Engineers	367	15	estimate
Chemists	3,306	911	estimate based on % for males same field
Spanish			
Chemical Engineers	644	11	estimate
Chemists	1,959	263	estimate

Based on a total of 107,000 chemists and 51,000 chemical engineers. Median years of schooling for chemical engineers 16.5 years, chemists 16.1 years. Thus, not all chemists or chemical engineers have the B.S. degree. Some data is based on a 5% sample; some data is based on 20% sample.

Appendix 3 Minority Census Data

	White	Negro	Total	Spanish
Male 25 and over				
Completed 4 years of college	3,367,827	103,756	3,518,159	68,174
Completed 5 years or more	3,329,027	92,008	3,490,403	81,716
Total	6,696,854	195,764	7,008,562	149,890
Female 25 and over				
Completed 4 years of college	2,028,136	166,215	3,139,445	53,045
Completed 5 years or more	1,437,738	93,980	1,569,259	33,864
Total	4,365,874	260,195	4,708,704	86,909

Negro females median years of school = 10.0
Negro males median years of school = 9.4
Spanish females median years of school = 9.9
Spanish males median years of school = 9.9
Whites and total median years of school both sexes = 12.1

Both genders combined				
Four years college	6,295,963	269,971	6,657,604	121,219
Five or more years	4,766,765	185,988	5,059,662	115,580
Total	11,062,728	455,959	11,717,266	236,799

Using the fact (developed by analyzing chemistry degrees from traditionally "black" colleges), that 1.8% of Negro college graduates take degrees in chemistry, we calculate 8,207 Negro B.S. chemistry degrees in the U.S.A. Using the same factor (1.8%) for the Spanish group, we get 4,262 degrees in chemistry.

The factor for all races is 1.6% to 1.7%. For all races, male, the factor is 2.67%; for Negro females 0.3%.

Since more Negro females graduate from college than Negro males, using the male factor for Negroes, we get 5,873 male Negro chemists; using the female factor for Negroes, we have 781 female Negro chemists. When gender is considered, Negroes show a decided drop from 8,207 to 6,654 B.S. chemists degrees. Doing the same for the Spanish group, we get 4,002 males, 260 females, 4,262 total. When gender is considered, the total number of chemists remains the same!

"Other" (Non white, non negro, non spanish).

Male 4 years college	46,576	Female 4 years college	45,094
5 years or more	69,368	5 years or more	37,541
Total	115,944	Total	82,635

Male Chemists = 2.6% of 115,944 or 3,014
Female Chemists = 0.3 of 82,635 or 249
Total 3,262 Other Minority B.S. chemists

Appendix 4

Minority Employment

(Based on a separate study of 6652 Respondents to the Survey)

Male 6191 (93.1%)
Female 461 (6.9%)
Total 6652

Answered Yes to Minority:

285 Male (4.3% of Total Respondents; 4.6% of Male Respondents)
31 Female (.5% of Total Respondents; 6.7% of Female Respondents)
316 Total (4.8% of Total Respondents)

Distribution of Minorities:

	Males			Females			Both	
Minority Group	#	% Total Respondents	% of Minority Males	#	% Total Respondents	% of Minority Female	#	% Total Respondents
Black	55	0.8	19.3	7	0.1	22.5	62	0.9
Amerind	10	0.2	3.5	0	0.0	-	10	0.2
Oriental	172	2.6	60.4	20	0.3	64.4	192	2.9
spanish	29	0.4	10.2	3	0.05	9.7	32	0.5
No Response	19	0.3	6.7	1	0.02	3.2	20	0.3

Non-response to minority question:

To the question, "Are you a member of one of the minority groups (Black, Amerind, Oriental, Spanish)?" we had, 137 Non-response, which included 14 questionable responses. (137/6652 = 2.1% 123/6652 = 1.8%). None of the respondents who identified themselves as female neglected to respond to the minority question.

Minority Employment Status:	Female (A)	%	(B)	%	Male (C)	%	(D)	%	All	%
Full-Time	361	78.3	23	74.2	5547	89.6	244	85.6	5908	88.8
Unemployed	17	3.7	2	6.5*	91	1.5	4	1.4*	108	1.6
Temporary	18	3.9	0	-	61	1.0	2	*	79	1.2
Student	22	4.8	5	16.1	176	2.8	28	918	198	3.0
Sub-Professional	14	3.0	1	*	98	1.6	5	1.8*	112	1.7
Retired Seeking	2	0.4	0	-	24	0.4	0	-	26	0.4
Retired	26	5.6	0	-	177	2.9	1	*	203	3.1
No Response	1	*	0	-	17	0.3	1	*	18	
	461		31		6191		285	Total	6652	

* Response rate too low for valid value
(A) Number of non minority women in this employment category
(B) Number of minority women in this employment category
(C) Number of non minority men in this employment category
(D) Number of minority men in this employment category

Appendix 5 Chemists' Salaries By Geographic Regions

	9.8% Pacific			3.1% Mountain			6.1% West North Central		
	B.S.	M.S.	Ph.D.	B.S.	M.S.	Ph.D.	B.S.	M.S.	Ph.D.
Overall	$16,800	$16,800	$20,500	$16,000	$16,100	$18,000	$16,000	$16,700	$19,000
Personnel	299	160	441	69	48	171	133	94	329
%	11.5	9.2	9.1	2.6	2.8	3.5	5.1	5.4	6.8

	6.5% West South Central			21.3% East North Central			3.7% East South Central		
	B.S.	M.S.	Ph.D.	B.S.	M.S.	Ph.D.	B.S.	M.S.	Ph.D.
Overall	$16,700	$15,300	$19,200	$16,500	$17,200	$20,000	$15,700	$18,000	$18,900
Personnel	173	119	303	597	393	965	102	67	170
%	6.6	6.9	6.3	22.9	22.6	20.0	3.9	3.9	3.5

	26.9% Middle Atlantic			15.8% South Atlantic			6.8% New England		
	B.S.	M.S.	Ph.D.	B.S.	M.S.	Ph.D.	B.S.	M.S.	Ph.D.
Overall	$17,000	$18,000	$21,700	$17,300	$17,700	$21,800	$17,000	$18,000	$20,200
Personnel	714	508	1,243	369	223	855	150	124	352
%	27.4	29.3	25.7	14.2	12.8	17.7	5.8	7.1	7.3