DOCUMENT RESUME

ED 152 849 TM 007 067

TITLE An Evaluation of the 1973 Survey of Doctoral Scientists and Engineers.
INSTITUTION National Academy of Sciences - National Research Council, Washington, D.C. Commission on Human Resources.
SPONS AGENCY National Science Foundation, Washington, D.C.
PUB DATE Nov 76
NOTE 51p.; For related document, see ED 089 646

EDRS PRICE MF-$0.83 HC-$3.50 Plus Postage.
DESCRIPTORS Chemistry; Comparative Analysis; *Doctoral Degrees; Earth Science; *Engineers; Foreign Students; *Graduate Surveys; Higher Education; Manpower Utilization; Mathematicians; *Occupational Surveys; Physics; Post Doctoral Education; Psychologists; *Research Reviews (Publications); *Response Style (Tests); Scientific Manpower; *Scientists; Sex Differences; Social Sciences; Statistical Bias; Tables (Data)

ABSTRACT

The Survey of Doctoral Scientists and Engineers (SDSE) itself was the first of a planned series of biennial surveys of manpower in the physical, life and social sciences, mathematics, and engineering, prepared for the National Science Foundation by the Commission on Human Resources of the National Research Council. This evaluation report attempted to examine the SDSE for evidence of nonresponse bias and to identify strengths and weaknesses for the improvement of future manpower studies. Analysis of the rate of survey response by sex, employment status, type of employer, and reported salary in the four successive survey mailings suggests that nonresponse had no effect on accuracy of estimates of manpower distribution. The SDSE gives an estimate of the number of U.S. science and engineering doctorate recipients who were awarded degrees as of July 1, 1972, and who were employed in the sciences as of spring 1973. It probably underestimated the number of foreign Ph.D.s employed in the U.S. by 25 to 40 percent. Specific results--when compared with membership studies conducted by the American Chemical Society, the American Psychological Society, and the American Institute of Physics--indicated the SDES is generally an accurate and reliable measure of population characteristics. (Author/CP)

An Evaluation of the 1973 Survey of Doctoral Scientists and Engineers

COMMISSION ON HUMAN RESOURCES

AN EVALUATION OF THE 1973 SURVEY OF DOCTORAL SCIENTISTS AND ENGINEERS

This report, prepared for the National Science Foundation, is based on the results of the 1973 Survey of Doctoral Scientists and Engineers.

Board on Human-Resource Data and Analyses
Commission on Human Resources
NATIONAL RESEARCH COUNCIL

NATIONAL ACADEMY OF SCIENCES
November 1976

NOTICE

This report is based on the 1973 Survey of Doctoral Scientists and Engineers, a project approved by the Governing Board of the National Research Council, whose members are drawn from the Councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The Survey project is part of the program of the Board on Human-Resource Data and Analyses.

A group other than the authors has reviewed this report according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

Available from:

Commission on Human Resources
National Research Council
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Washington, D.C. 20418

ACKNOWLEDGMENTS

The 1973 Survey of Doctoral Scientists and Engineers, sponsored by the National Science Foundation as part of its Manpower Characteristics System, was conducted by the Commission on Human Resources of the National Research Council. This report examines the survey results for evidence of response bias and attempts to point out some strengths and weaknesses in the survey results.

We are indebted for the conceptualization and initial draft of the report to Dr. Lee Grodzins, Professor of Physics at the Massachusetts Institute of Technology. Technical reviews of the report were conducted by Dr. Lyle Jones, Vice-Chancellor and Dean, Graduate School, University of North Carolina; and Ms. Beverly Porter, American Institute of Physics. Dr. David Breneman, Senior Fellow, Brookings Institute; and Dr. Winton Manning, Vice-President of the Educational Testing Service, also read drafts of the report.

Dr. Benjamin Tepping (retired), former Chief of the Research Center for Measurement Methods, U.S. Bureau of the Census, and statistical consultant to the Comprehensive Survey Project, was very helpful to the Project Staff in the final revision of the report and in the development of the data base for the referenced survey data. Ms. Nancy Ahern, Research Assistant, updated the survey data that appears in the report; Dr. Betty Maxfield, Project Director, revised the text of the report; and Mr. Andrew Spisak, Research Assistant, edited the final version. Ms. Dorothy Gilford, Director of Human Resource Studies, provided general administrative advice.

Betty D. Maxfield
Project Director

AN EVALUATION OF THE 1973 SURVEY OF DOCTORAL SCIENTISTS AND ENGINEERS

The 1973 Survey of Doctoral Scientists and Engineers in the United States (SDSE) was the first of a planned series of biennial surveys. The sampling base for the SDSE was the Comprehensive Roster of Doctoral Scientists and Engineers, hereafter referred to as the Comprehensive Roster (CR). The Comprehensive Roster consists of information on scientists[1] from the Doctorate Records File, a file containing names and information on individuals who received Ph.D.'s from U.S. universities from 1920 to the present. Supplemental sources were used to secure names of foreign Ph.D.'s and nonscience Ph.D.'s in science and engineering jobs in the U.S. The results of the first survey were published in 1974.[2]

The present study attempts to: 1) examine the survey for evidence of bias arising from nonresponse, and 2) point out some strengths and weaknesses in the SDSE results so they can be used more effectively for manpower studies.

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[1] The word "scientist" will be used to refer to physical, life, and social scientists as well as mathematicians and engineers.

[2] Doctoral Scientists and Engineers in the United States, 1973 Profile, National Academy of Sciences, March 1974. ED 089 646

To accomplish these goals, the following analyses were done:

- An analysis of the employment status and salary reported in the several waves of the survey.
- A comparison of specific SDSE results with independent studies carried out by selected scientific societies.

CONCLUSIONS

I. The several successive mailings in the survey to nonrespondents resulted in essentially similar estimates of the distribution of doctoral scientists and engineers in the U.S. by sex, employment status, type of employer, and salary, suggesting, although perhaps not proving, that the nonresponse in the survey probably had no appreciable effect on the accuracy of these estimates.

II. The SDSE gives an estimate of the number of U.S. science and engineering doctorate recipients who were awarded their degrees as of July 1, 1972, and who were employed in the various segments of the U.S. scientific community as of Spring 1973.

If the size of the total scientific labor force for Spring 1973 is required, one would have to include those Ph.D.'s awarded degrees between July 1, 1972, and the survey date.

III. The SDSE probably underestimates the number of foreign Ph.D.'s employed in science in the U.S. by 25 percent to 40 percent (2,500 to 4,500 Ph.D.'s). Most of this under-representation is accounted for by Ph.D.'s granted after 1964. Most of these Ph.D.'s appear to have postdoctoral appointments.

IV. In general, the results of the SDSE are in agreement with several surveys conducted by the professional societies and indicate that

the SDSE is an accurate and reliable measure of population characteristics.

A. The SDSE results for all broad fields and for those fine fields of science with well defined boundaries, such as astronomy, give accurate profiles of manpower distributions.

B. The SDSE results for nuclear physics are not in good agreement with American Institute of Physics (AIP) data. Nuclear physics is an example of a field with poorly defined boundaries resulting in substantial ambiguities in field identification. Since the SDSE examines all fields simultaneously, it yields more complete data on manpower mobility between overlapping fields.

C. The results of the SDSE for estimating faculty by rank in Ph.D.-granting institutions are highly reliable.

Introduction

The National Register of Scientific and Technical Personnel, hereafter referred to as the Register, was a survey of the U.S. scientific community and was maintained by the National Science Foundation from 1954 to 1970.[3] In 1972 NSF replaced the Register with three manpower surveys: The National Sample conducted by the Census Bureau, the New Entrants Surveys conducted by UCLA, and the SDSE.

The 1973 SDSE, based on a sample from the Comprehensive Roster, was carried out in the Spring of 1973. It differed from the Register surveys in the following ways:

- The SDSE excluded non-Ph.D. scientists, but included engineering doctorate holders and an increased number of doctorates in the social and life sciences.
- The Doctorate Records File of the National Research Council was used as a population source for the CR, thus assuring that the universe of U.S. Ph.D.'s in the CR was essentially complete. Supplemental sources such as the Register, American Men and Women of Science, The National Faculty Directory, college catalogs, professional societies, science and engineering departments, and alumni offices were used to secure information on foreign and nonscience Ph.D.'s working in science and engineering fields.

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[3] The American Science Manpower Series, based on the National Register of Scientific and Technical Personnel, was published by the National Science Foundation for the periods 1954, 1956-58, 1962, 1964, 1966, 1968, and 1970.

- A stratified sample of about 20 percent of the doctoral population from the CR was surveyed.

Survey Procedures

The Comprehensive Roster (CR) of 272,234 doctoral scientists and engineers was compiled from the Doctorate Records File (DRF) as well as from other available sources. The DRF contains data on all persons who, from 1920 to the present, earned a doctorate (Ph.D. or equivalent) at a U.S. university. It consists of over 472,000 individual records. Both the CR and the DRF are maintained by the Commission on Human Resources; therefore, without violating confidentiality of records, it was possible to secure biographical information for a high percentage of the Ph.D. scientists and engineers who were awarded degrees by U.S. universities between 1930 and June 1972. The actual population figure for individuals working in science or engineering with foreign Ph.D.'s and nonscience Ph.D.'s was not known, but was estimated to be a rather small percentage of the total U.S. doctorate population for each group.

A sample of 59,086 individuals was selected from the Comprehensive Roster. The sample was stratified by field[4], year of Ph.D., sex, doctoral institution size, and category of Ph.D. (U.S. science, U.S. nonscience, or foreign). The sampling ratios were approximately 20 percent for the principal groups, with sampling rates ranging from 11 percent for the largest cells to 100 percent for some of the smallest cells including women, nonscience Ph.D.'s or foreign Ph.D.'s.[5]

[4] See Appendix A for a list of the stratified fine-field categories.

[5] See Appendix B for the population/sample stratification figures.

In March 1973 the SDSE questionnaires were mailed to approximately 59,000 scientists and engineers. Three follow-up mailings to non-respondents were conducted in the months of May, August, and October of 1973. The number of survey responses as of November 26, 1973, was 42,456; in addition, 1,561 persons in the sample were found to be deceased. Thus, information about 44,017 individuals was collected, yielding response rates of 74.5 percent of the total sample and 79.0 percent of those contacted.

Bias of Nonresponse

When, as in this survey, there is a series of mailings to the sample, each mailing being addressed to those members of the sample that did not respond to previous mailings, a customary method of examining the effect of nonresponse is to compare the estimates of population characteristics that would have been made from the several waves of mailings.

Appendix C displays the distribution of doctoral scientists and engineers in the U.S. by sex and employment status (both unweighted sample numbers and weighted to estimate population totals) for each of the four waves of mailing and for the whole set of responses. The percentages shown (labelled "V") are based on the weighted numbers. It should be noted that although, in view of the sample sizes involved, the differences are not likely to have arisen from chance alone (that is, that they are statistically significant), it is apparent that the distributions given by the several waves do not differ substantially (that is, they do not appear significant in the less technical sense).

For example, for males the proportion employed full-time in science is shown as 85.8 percent for the first wave and as 81.8 percent for the second wave, based on 23,778 responses in the first wave and 5,166 responses in the second wave. Even ignoring the effects of stratification in the selection of the sample and treating the results as if they arose from simple random samples of these sizes, the standard error of the difference of the two proportions is only about 0.6 percent, or only about 1/7 of the difference observed. For females, the standard error of the difference between the same two proportions is less than 1/3 of the difference observed. Thus, the data hint that nonresponse may have produced a slight over-estimate of the proportion of scientists who are employed full-time in science. Nevertheless, the differences among the waves are small from a substantive point of view.

Appendix D gives the distribution by sex and type of employer. Again, the differences among the waves are small, with a hint that the proportion not employed may have been under-estimated slightly as a result of nonresponse.

Appendix E shows the estimated distribution of annual salaries of doctoral scientists and engineers employed full-time, by sex. Table I gives the percentage distributions, based on the sample responses that reported salary. Once more, it appears that the distributions for the several waves are very similar, with no evidence that nonresponse has affected the estimates appreciably.

The response rates as a function of region of employment, Roose-Andersen rating, B.A. to Ph.D. time lapse, fine fields of Ph.D., and

TABLE I

ESTIMATED PERCENTAGE DISTRIBUTION OR ANNUAL SALARY, BY SEX

Sex and Annual Salary	Wave				
	All	1st	2nd	3rd	4th
Both sexes					
Less than $5000	0.3	0.3	0.4	0.3	0.5
$5000-9999	0.8	0.7	1.1	0.6	0.1
$10000-14999	10.4	10.4	10.9	9.6	6.1
$15000-19999	33.2	33.2	32.8	33.6	37.4
$20000-24999	28.5	28.6	27.7	28.4	31.9
$25000-29999	14.3	14.3	14.6	14.0	12.6
$30000-34999	7.0	6.9	7.4	7.0	6.4
$35000-39999	3.1	3.2	2.8	3.2	2.4
$40000-44999	1.1	1.1	1.0	1.1	2.3
$45000-49999	0.4	0.4	0.3	0.7	0.0
$50000 or more	0.9	0.8	0.9	1.6	0.2
Median Salary	$20,887	$20,894	$20,817	$20,986	$20,876
Male					
Less than $5000	0.2	0.2	0.3	0.2	0.5
$5000-9999	0.6	0.6	1.0	0.6	0.0
$10000-14999	9.5	9.5	10.0	8.6	4.9
$15000-19999	32.5	32.6	31.9	33.1	37.1
$20000-24999	29.0	29.3	28.3	28.8	32.4
$25000-29999	14.8	14.8	15.3	14.3	12.9
$30000-34999	7.3	7.2	7.8	7.4	6.8
$35000-39999	3.3	3.4	3.0	3.4	2.6
$40000-44999	1.1	1.1	1.0	1.2	2.5
$45000-49999	0.4	0.4	0.4	0.7	0.0
$50000 or more	0.9	0.9	1.0	1.7	0.2
Median Salary	$21,165	$21,167	$21,130	$21,253	$21,098
Female					
Less than $5000	0.9	0.8	1.3	1.2	0.0
$5000-9999	2.8	3.1	2.6	0.6	2.1
$10000-14999	23.2	23.8	22.1	22.5	23.2
$15000-19999	42.4	42.9	43.8	39.8	40.8
$20000-24999	19.7	19.4	20.0	23.3	24.6
$25000-29999	6.6	6.6	5.5	10.0	9.2
$30000-34999	2.4	2.4	2.8	2.2	0.0
$35000-39999	0.6	0.6	1.0	0.4	0.0
$40000-44999	0.3	0.3	0.2	0.0	0.0
$45000-49999	0.0	0.0	0.0	0.0	0.0
$50000 or more	0.1	0.0	0.7	0.0	0.0
Median Salary	$17,619	$17,551	$17,696	$18,173	$17,967

the survey stratification criteria were reviewed, and in general were found to vary by not more than five to ten percent. Appendix B gives the response rates for the stratification criteria, and additional information on the response rates for the other groups can be made available on request.

There may be a small bias due to those not contacted because current addresses were not available (5.7% of the sample) in the first wave of the mailing. A study of nonresponse bias, including this group, is planned for early 1977. This study will address itself to many of the conclusions reached in this report with respect to the effects of bias due to nonresponse.

Science Employed Population.

A count of the number employed in various fields is an important statistic from the survey. It is necessary, however, to note ambiguities in the definitions of employment and unemployment and in the suitability of the categories themselves. For example, the timing of the survey plays an important role in determining the validity of data of transient groups such as postdoctorates.

In the 1973 Profile[6] the estimated number employed in each broad field of science as of Spring 1973 was summarized; these numbers plus the Spring 1972 figures are given in Table II. The numbers show the employed science population for 1973 to be less than that for 1972, which is not correct. The 1973 results omitted all Ph.D.'s entering

6 Doctoral Scientists and Engineers in the United States-1973 Profile, National Academy of Sciences, Washington, D.C., March 1974, p. 5.

the scientific labor market between July 1, 1972, and the survey date in 1973,[7] and a crude estimate of that omission is about 50 percent of the FY 1973 Ph.D. output of 19,800 scientists and engineers; that is, the population of employed scientists actually increased by roughly 3.5 percent, if no allowance is made for losses by death or change of occupation.

TABLE II

SCIENCE EMPLOYED 1972 and 1973		
	SDSE 1972	SDSE 1973
Mathematics	15,298	15,104
Physics	17,825	17,029
Chemistry	28,852	27,836
Earth Science	10,048	10,289
Engineering	34,309	34,550
Bioscience	56,929	56,763
Psychology	24,907	24,598
Social Science	26,456	26,182
TOTAL	214,624	212,351

Foreign Ph.D.'s and Postdoctorates

Foreign doctorates are under-represented in the Comprehensive Roster, particularly those earning Ph.D.'s after about 1966. The ratio of foreign to U.S. Ph.D.'s in the sample as a function of Ph.D. year is given in Appendix F.

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[7] It is worth commenting here that the SDSE asked those surveyed about their employment at the time they answered the survey. The mean date for all respondents was the middle to end of April.

The postdoctoral population is a transient population and, as such, is poorly defined. The SDSE used a broad definition for postdoctorates (including fellowship, traineeship, research associateship, etc.), yet the survey results indicate fewer postdoctorates than the NSF 1973 survey of academia in which "postdoctorate" was more sharply defined.

The NSF survey[8] of graduate departments in the Fall of 1972, and again in the Fall of 1973, reported considerably more postdoctoral appointments in each field than does the SDSE (Table III). Also, the 1973 American Institute of Physics' survey showed a postdoctoral population of about 1,900; approximately 30 percent more than the NSF figure, and more than twice the SDSE number. However, government laboratories, industries, and various nonprofit institutions have substantial numbers of postdoctoral appointees in physics, chemistry, and bioscience. Thus, the discrepancies between the SDSE results and the true postdoctoral population are likely to be even greater than implied in Table III.

To compare survey results of postdoctoral population, one needs to examine how and when the surveys were conducted. The NSF survey of academia is sent out in the Fall and answered by department heads (NSF results for 1972 and 1973 are given in Table III).

The AIP survey, sent in the Spring of 1973, interrogated many physicists (Ph.D.'s and non-Ph.D.'s), and included those who took postdoctoral positions up to the survey time. The AIP results for

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8 Graduate Student Support and Manpower Resources in Graduate Science Education, 1971, 1972, 1973, NSF.

TABLE III

POSTDOCTORAL POPULATIONS ACCORDING TO VARIOUS SOURCES									
	Math	Physics Plus Astron.	Chem.	Earth	Engr.	Bioscience	Psych.	Soc. Sci.	Total Science Ph.D.'s
SDSE Survey of 1973*									
1. March 1973	92	912	1415	144	218	2543	262	270	5919
2. March 1972	155	1176	1826	195	377	3369	480	217	7795
Recent Ph.D.'s									
3. One-half the total Number of Ph.D. Postdoc Expected in 1973 (DRF Data)	57	357	456	76	152	814-988‡	151	85	2322
4. Lines 3 + 1	149	1269	1871	220	533	3531	413	355	8341
NSF Graduate Science Education Series† Totals in all Graduate Departments									
5. Fall 1973 - Total	145	1387	2413	323	975	5549-10520‡	190	404	11386-16357
6. Fall 1972 - Total	228	1536	2445	361	920	4729- 7225	489	395	11103-13599
AIP 1973 Survey									
7. In Academia		1425							
8. TOTAL		1900							

* The SDSE Survey asked for employment information for March 1972 as well as for March 1973. A postdoctoral appointment was not clearly defined, but included explicitly "fellowship, traineeship, research associateship, etc."

† A Postdoctoral and/or Research Associate is defined fully using definitions from The Invisible University. An explicit criterion is full-time in research, without academic rank.

‡ Lower number excludes clinical postdoctorates.

academia compare well with those of NSF; each claiming that in Spring 1973 about 1,400-1,500 Ph.D.'s were employed in academia as post-doctorates in physics.

The SDSE figure for physics, given in Table III, is 912 post-doctorates in March 1973. This includes those Ph.D.'s awarded degrees prior to July 1, 1972. To be accurately compared with other surveys, this figure must be increased by the number of July 1972-March 1973 Ph.D.'s who took postdoctorates in physics prior to March 1973. A reasonably accurate figure for comparison with the other surveys listed is 1,269 (912 + 357) postdoctorates in physics (357 is half the number of Ph.D.'s who indicated on the DRF questionnaire that they expected to accept postdoctorate appointments in 1973).

The remaining discrepancy in these figures may be due to the omission of large numbers of postdoctoral scientists and engineers with foreign doctorates. This conclusion is strengthened by the knowledge that the 1973 SDSE only records 160 foreign Ph.D.'s in a postdoctoral population of 6,000. A three percent foreign Ph.D. component must be contrasted with the figures reported in The Invisible University[9] that indicated 42 percent of all postdoctoral appointees in academia in 1966 were foreign citizens with foreign Ph.D.'s.

In summary, the following conclusions are made:

- In 1973 there were at least 11,300 and probably nearer 14,000

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[9] The Invisible University, Postdoctoral Education in the United States, National Academy of Sciences, 1969.

postdoctorates in science or engineering in the U.S.

- At least 25 percent and quite possibly 40 percent of this number held foreign Ph.D.'s.
- The SDSE survey underestimates the postdoctoral population by inadequately covering the foreign Ph.D.'s.

The Nonscience Ph.D.'s

Approximately four percent of all science employed Ph.D.'s in the U.S. hold nonscience doctorates. An examination of the SDSE and DRF questionnaires for about 10 percent of the stratified sample of this group reveals that most of this group (between 75 percent and 95 percent) have at least one, and more often two, science degrees (B.S. and/or M.S.) and a Ph.D. in a nonscience field. Forty percent of the Ph.D.'s are in the field of education; another 10 percent are in business administration. At least 75 percent of the nonscience Ph.D.'s are teaching in the field of their minor and cannot rightly be considered field switchers.

The population of nonscience Ph.D.'s in science jobs is poorly defined. The classification itself is often a statement of personal attitude. We do not know whether the universe is the 8,000 indicated by the survey,[10] or twice that number. But, since this group is predominately in education where it is visible and accessible, it is likely that representation in the survey is reasonably complete.

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[10] See Appendix G.

Unemployment

Are the unemployment rates biased? In particular, is there a significant omission from the SDSE response for those unemployed and seeking employment?

Surveys similar to the SDSE give similar unemployment statistics. For example, the American Chemical Society (ACS) reported an unemployment rate of 1.5 percent for Ph.D. chemists,[11] whereas the SDSE reports 1.7 percent. The American Institute of Physics (AIP) reported a 1.2 percent unemployment rate for Ph.D. physicists,[12] the SDSE a 1.5 percent rate.

Comparison with Other Surveys

Several scientific societies carried out studies of their memberships in 1972-73. A few were selected for comparison with the SDSE (i.e., chemistry (ACS), psychology (APA), and physics (AIP)).

A. American Chemical Society Survey

The 1973 Report of Chemists' Salaries and Employment Status,[13] published in August 1973 by the American Chemical Society (ACS), provides information on basic annual salary and total professional income. The SDSE asked for basic annual salary only. The results of the two surveys (Figure 1) were compared where median annual salaries

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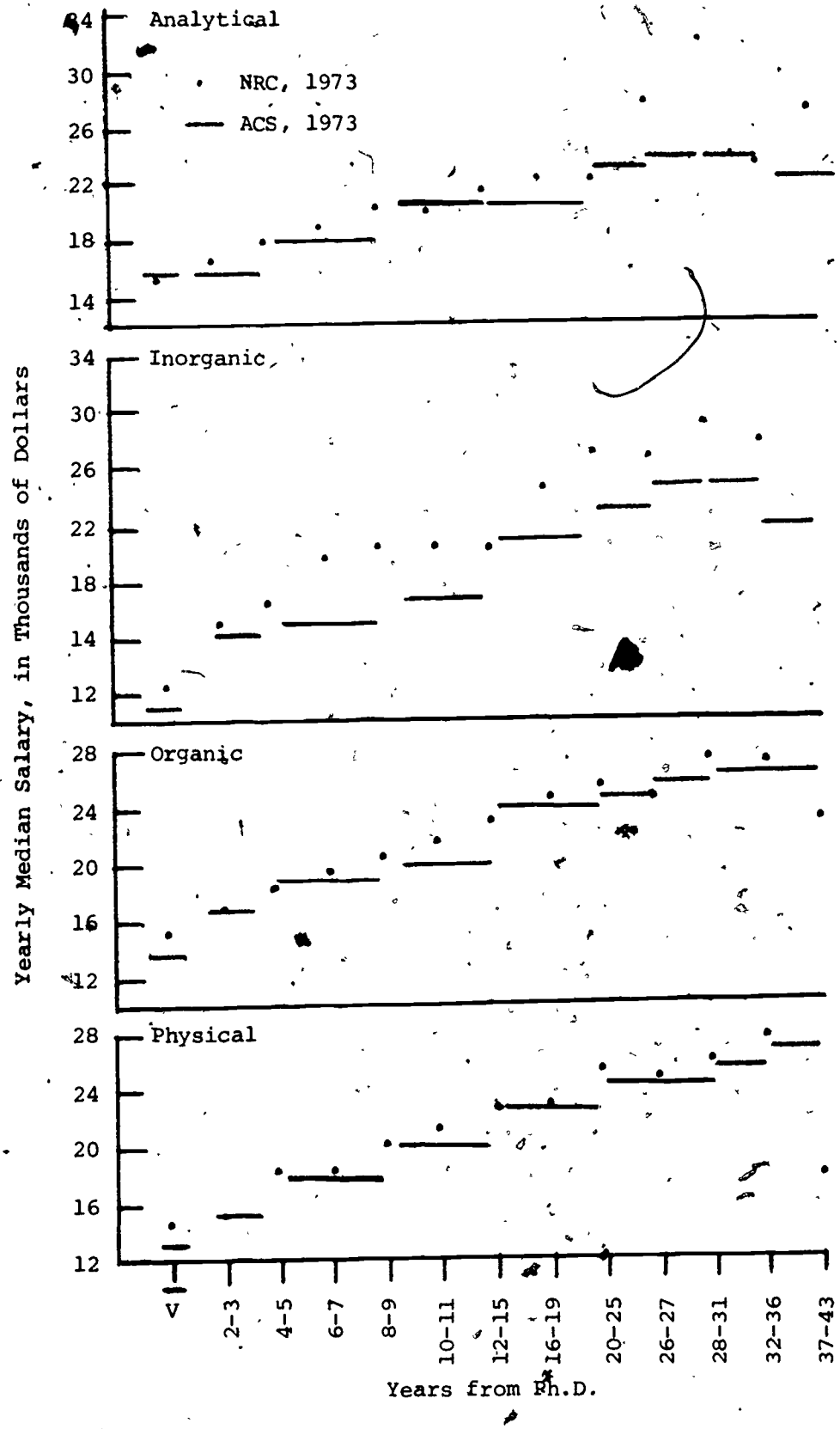
11 1973 Report of Chemists' Salaries and Employment Status, American Chemical Society.

12 "A First Look at the Register," B. Porter, S. Barisch, R. Sears, Physics Today, April 1974.

13 See Footnote 11.

FIGURE 1

SALARIES OF EMPLOYED PH.D. CHEMISTS



for doctoral chemists in four fine fields were given as a function of years of experience. The results are quite similar although the ACS consistently reported lower median salaries.

The ACS surveyed 25 percent (13,600) of its members (Ph.D.'s and non-Ph.D.'s) for its survey, while the SDSE surveyed an 18 percent (7,900) sample of Ph.D. chemists. Responses were received from 573 analytic, 431 inorganic, 1,526 organic, and 882 physical chemists in the ACS survey of its members. Corresponding figures for Ph.D.'s in the SDSE were 362, 681, 1,833, and 1,347. The disparity in numbers leads one to credit the discrepancy to the biases inherent in a survey confined to society members rather than a sample of the total population or to the difference in survey samples. ACS included both Ph.D. and non-Ph.D. chemists in its survey; whereas, SDSE included only Ph.D.'s. In particular, it is suspected that the response to the ACS survey under-represented industry where salaries are considerably higher.

B. American Psychological Association Survey

The American Psychological Association (APA) conducted a survey of its membership in 1972 for the purpose of updating its biographical directory. A summary of the findings were published by the APA Clearing House for Information on Psychology's Manpower.[14] Although the SDSE and APA surveys were conducted one year apart, it is meaningful to compare the employment distribution of doctorates among

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[14] 1972 Survey of Psychologists in the U.S. and Canada / American Psychological Association.

the subfields of psychology since such distributions change slowly and do not depend much on the total number surveyed (see Table IV). The SDSE results are in excellent agreement with those from APA.

C. American Institute of Physics Survey

In February 1973 the American Institute of Physics (AIP) surveyed all known physicists, not just its membership. Extensive use was made of the National Register of Scientific and Technical Personnel; the Comprehensive Roster was not used. The response rate for doctorates was estimated to be approximately 85 percent. The survey questionnaire was similar to that used in the SDSE and comparisons may give some indication of the reliability of the SDSE, particularly for fine field analysis.

A comparison of the employment figures in the fine fields of physics is given in Table V where data represents numbers of respondents without scaling up to take account of the nonresponding population (i.e., the SDSE estimates population figures and the AIP survey gives only the number of respondents). There are substantial differences between the surveys but two important conclusions should be noted. Both surveys yield similar results for each fine field and for the sum of all fields. One difference in the populations of fine fields results from the AIP's use of a more extensive list of fine field classifications. AIP did not have a category called "Other," whereas the SDSE did. Furthermore, the AIP identified theorists explicitly; the SDSE did not.

TABLE IV

EMPLOYMENT SUBFIELD DISTRIBUTIONS OF THE AMERICAN PSYCHOLOGICAL ASSOCIATION

	APA Data (1972) %	SDSE* (1973) %
General	1.4	4.0
Systems	1.6	---
Experimental	9.1	10.0
Physiological	2.4	4.2
Compositive/Animal	0.6	1.0
Developmental	4.8	4.7
Social	6.3	6.5
Personality	1.8	1.5
Psychometrics	1.1	2.0
Educational	7.7	7.0
Engineering	0.9	---
Industrial/Organizational	6.1	6.0
Clinical	36.5	33.8
Community	1.9	---
Counseling	11.2	8.8
School	4.3	3.9
Other	2.5	6.5
TOTAL NUMBER	18,558	24,602

* The SDSE does not list all the fields listed by the APA.

Frequently, the problem of field identification[15] is troublesome in physics, a field which is known for its emerging science (i.e., biophysics, nuclear engineering, medical physics, geophysics). A general observation is that the surveys give equivalent results for well defined fields (astronomy), but compare poorly for fields, such as nuclear physics, which are not easily categorized. To obviate this problem, data based on field of the Ph.D. rather than field identification was used for comparisons of the employment subfield distribution.

The final comparisons in this subsection give the distribution among types of employers for those employed in physics (Table VI). The differences in Table VI are undoubtedly due to the discrepancies in deciding who is an employed physicist. In particular, the SDSE results are based on the 17,000 employed in traditional areas of physics while the AIP results are based on 19,600 employed in both traditional and border areas, such as electronics. The differences between the percentages are due to the heavy concentration of the border fields in the industrial sector.

An interesting definitional (and sociological) problem is observed for the Federally Funded R&D Laboratories (FFR&D). These federally funded laboratories are operated by universities, industries,

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15 The National Science Foundation has used field of identification as the basis of its classification system. Field of identification is defined, for those employed in science or engineering positions (including postdoctoral appointees), as the field of employment and, for all others (including those unemployed, those retired, housewives, those not reporting), as the field of doctorate.

Frequently, the problem of field identification[15] is troublesome in physics, a field which is known for its emerging science (i.e., biophysics, nuclear engineering, medical physics, geophysics). A general observation is that the surveys give equivalent results for well defined fields (astronomy), but compare poorly for fields, such as nuclear physics, which are not easily categorized. To obviate this problem, data based on field of the Ph.D. rather than field identification was used for comparisons of the employment subfield distribution.

The final comparisons in this subsection give the distribution among types of employers for those employed in physics (Table VI). The differences in Table VI are undoubtedly due to the discrepancies in deciding who is an employed physicist. In particular, the SDSE results are based on the 17,000 employed in traditional areas of physics while the AIP results are based on 19,600 employed in both traditional and border areas, such as electronics. The differences between the percentages are due to the heavy concentration of the border fields in the industrial sector.

An interesting definitional (and sociological) problem is observed for the Federally Funded R&D Laboratories (FFR&D). These federally funded laboratories are operated by universities, industries,

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15 The National Science Foundation has used field of identification as the basis of its classification system. Field of identification is defined, for those employed in science or engineering positions (including postdoctoral appointees), as the field of employment and, for all others (including those unemployed, those retired, housewives, those not reporting), as the field of doctorate.

nonprofit organizations, and government. On the SDSE questionnaire, the ambiguity in characterizing the type of employer is illustrated by the fact that 41 percent of those working in university-operated FFR&D laboratories answer that they are employed by a university, 33 percent indicate they are employed by government, and 25 percent report they are employed by a nonprofit organization.

TABLE VI

DISTRIBUTIONS AMONG TYPES OF EMPLOYER FOR DOCTORATES EMPLOYED IN PHYSICS OR ASTRONOMY, A COMPARISON OF THE 1973 SDSE AND AIP SURVEYS

Type of Employer	SDSE	AIP
Universities and Colleges	53.6%	50.9%
Industry*	20.7%	22.4%
Government†	11.6%	10.6%
FFR&D	11.3%	11.7%
Junior College and Secondary School	1.3%	1.4%
Nonprofit	1.2%	3.1%
Total Number Employed	17,000	19,600

* Includes self-employed.

† Includes federal, state, other government, and military and government-run National Laboratories

Fine Fields of Physics

A. Astronomy and Astrophysics

The field of astronomy (including astrophysics) is reasonably well defined; there is little difficulty in determining if this is an individual's principal field. Therefore, it is not surprising that the

SDSE results show considerable agreement with those of the 1973 AIP survey.

In Table VII the two surveys are compared according to various categories of training and employment. The degree of agreement between the two surveys is excellent.

TABLE VII

ASTRONOMY
COMPARISON OF AIP 1973 AND SDSE 1973

	AIP/0.85*	SDSE
Number of Astronomy Ph.D.'s	1,335	1,400
Number of Astronomy Ph.D.'s, working in Astronomy	1,041	1,054
Number Employed in Astronomy	1,545	1,623
Astronomy Trained, working in Astronomy	1,093†	1,054
Not Astronomy Trained, working in Astronomy	452	569
Physics Ph.D.	---	446
Nonphysics Ph.D.	---	123
Astronomy Trained, working in Physics and other non-Astronomy fields	291	265
Physics	---	112
Other Science	---	109
Nonscience	---	44

* The best estimate for the AIP survey response rate is 0.859.

† Includes non-Ph.D. astronomy-trained.

B. Nuclear Physics

Nuclear physics represents a subfield which overlaps with other fields of physics, as well as chemistry, engineering, and medicine-biology. The discrepancy between the SDSE and AIP results for nuclear physics in Table V are larger than for any other traditional fine field of physics.

The number of scientists employed as nuclear physicists is 1,288 according to the SDSE and 1,583 according to the AIP. The SDSE survey undoubtedly underestimates the number of nuclear physicists, but the main difference appears to be due to different classifications.

Comparison with an Academic Census

All of the surveys discussed in this report have either been used to examine the internal consistency of the SDSE or to compare SDSE results with those of other surveys. It is possible, indeed highly probable, that the compared surveys are similarly biased. There is, however, one type of data which may provide a benchmark, the Directory of Physics Faculties published by AIP. The Directory lists faculty ranks for every university in the country.

In Table VIII a comparison between the SDSE and the census count is made by faculty rank for Ph.D.-granting physics and astronomy departments only. It is assumed that essentially all faculty in Ph.D.-granting physics/astronomy departments hold doctorate degrees. The only significant difference is for the rank of professor but the difference of about 150 professors is explained by the 100-200 professors emeritus who are still employed and are, therefore, listed

in the SDSE survey but are not included in the tabulations of the Directory.

TABLE VIII

FACULTY IN PH.D.-GRANTING
PHYSICS AND ASTRONOMY DEPARTMENTS
1972-73

A COMPARISON OF THE AIP CENSUS
WITH THE RESULTS FROM THE 1973 SDSE SURVEY

	Number of Faculty by Rank in U.S. Ph.D.-Granting Departments				
	Prof.	Assoc.	Asst.	Inst.	Total
AIP Directory of Physics and Astronomy Faculties, 1972-73*†	2,298	1,414	1,116	90	4,918
1973 SDSE Survey‡	2,445	1,408	1,194	80	5,127
$\frac{\text{AIP - SDSE}}{\text{AIP}}$ x 100§	-6.4±2%	+0.4±3%	-7±3%	11±11%	-4±1.5%

* Faculties in 203 departments awarding a Ph.D. in physics or astronomy at 162 separate campuses.

† Excludes emeritus, adjoint, visiting, and research professors.

‡ Counts an estimated 100 employed emeritus professors.

§ The error here is based solely on the SDSE respondent rate (taken to be 80 percent) and sample size. The AIP numbers are assumed to have no statistical errors.

The close agreement in the absolute numbers for physics faculties in Table VIII lend support to the reliability of the SDSE in measuring the population of all science faculties in Ph.D.-granting institutions. Excellent results are expected since academic manpower contains few of the elements that lead to biases; e.g., recent foreign Ph.D.'s, 1973 Ph.D.'s, or uncertain definitions.

APPENDICES

APPENDIX A

FINE FIELD STRATA FOR PH.D.'S GRANTED IN THE U.S. SINCE 1958

Mathematics

- Algebra, Analysis
- Probability, Computing, Operations Research, Applied
- Other

Physics

- Elementary Particles
- Nuclear Structure
- Solid State
- Other

Chemistry

- Inorganic
- Organic
- Physical
- Other

Earth Sciences

Engineering

- Civil
- Chemical
- Electrical, Electronics
- Mechanical, Mechanics
- Other

Biosciences

- Agriculture
- Medical
- Anatomy, Cytology Physiology
- Biochemistry
- Microbiology, Genetics
- Zoology, Entomology
- Other

Psychology

- Clinical
- Experimental, Comparative, Physiological
- Other

Social Sciences

- Anthropology, Sociology
- Economics, Econometrics
- Political Science, International Relations
- Other

APPENDIX B

POPULATION, SAMPLE AND STRATIFICATION

	Doctoral Roster Total*	Total Sample	Sample Total %	Response	Deceased	Nonresponse†	Not Contacted‡	% Not Contacted
Total	272,234	59,086	21.7	42,456	1,561	11,683	3,386	5.7
Field of Ph.D./Employment								
Mathematics	15,919	4,409	27.7	3,146	83	966	194	4.4
Physics/Astronomy	24,659	5,139	20.8	3,670	109	1,087	273	5.3
Chemistry	43,113	7,907	18.3	5,830	202	1,460	415	5.2
Earth Sciences	8,525	1,986	23.3	1,497	81	315	93	4.7
Engineering	38,518	6,362	16.5	4,633	97	1,306	326	5.1
Biosciences	68,955	17,091	24.8	12,368	478	3,044	1,201	7.0
Psychology	30,983	7,128	23.0	5,084	197	1,489	358	5.0
Social Sciences	40,265	8,142	20.2	5,555	299	1,856	432	5.3
Nonsciences/Unknown	1,297	922	71.1	653	15	160	94	10.2
Year of Ph.D.								
CY1930-35	9,927	2,393	24.1	1,302	426	390	275	11.5
CY1936-41	12,254	2,787	22.7	1,777	334	467	209	7.5
CY1942-45	6,501	1,773	27.3	1,187	129	334	123	6.9
CY1946-49	10,088	2,356	23.4	1,639	123	430	164	7.0
CY1950-53	21,770	4,266	19.6	3,056	151	783	276	6.5
CY1954-57	24,920	4,847	19.5	3,603	104	884	256	5.3
CY1958-FY61	26,039	5,733	22.0	4,126	110	1,252	245	4.3
FY1962-63	17,711	4,695	26.5	3,410	69	996	220	4.7
FY1964-65	22,481	5,488	24.4	3,977	36	1,155	320	5.8
FY1966-67	27,529	6,244	22.7	4,566	33	1,285	300	5.8
FY1968-69	33,401	6,978	20.9	4,999	23	1,509	447	6.4
FY1970-71	39,371	7,481	19.0	5,652	15	1,475	339	4.5
FY1972	19,774	3,699	18.7	2,975	5	617	102	2.8
Unknown	465	346	74.4	187	3	106	50	14.5
Category of Ph.D.								
U.S. Science	252,190	48,870	19.4	25,016	1,423	9,916	2,515	5.1
U.S. Nonscience	9,669	5,010	51.8	4,060	81	729	140	2.8
Foreign	10,375	5,206	50.2	3,380	57	1,038	731	14.0
Size of Ph.D. Institution§								
Less than 50	15,190	6,615	43.5	4,708	232	1,354	321	4.9
50 to 299	98,404	18,479	18.8	13,248	524	3,842	865	4.9
More than 299	138,596	23,776	17.2	17,060	667	4,720	1,329	5.6
Unclassified	20,044	10,216	51.0	7,440	138	1,767	871	8.5
Sex								
Male	248,653	47,675	19.2	34,472	1,210	9,369	2,624	5.5
Female	23,581	11,411	48.4	7,984	351	2,314	762	6.7

* Figures include those deceased and those employed in foreign countries and hence exceed the total population figures reported in other tables from the 1973 Profile Report.

† Includes those to whom survey forms were mailed and not returned as well as those who indicated their reluctance to participate in the survey.

‡ Includes those who were members of the sample but for whom no current addresses could be found.

§ Size determined by the number of doctorates granted by an institution during a given time period (cohort).

APPENDIX C

NUMBER OF DOCTORAL SCIENTISTS AND ENGINEERS IN THE U.S.
BY SEX, EMPLOYMENT STATUS, AND RESPONSE GROUP
TOTAL BOTH SEXES

1973 Employment Status		Total Respondents	1973 Survey Response Group 1st Form	2nd Form	3rd Form	4th Form
Total All	N	38,235	29,112	6,488	2,199	436
	WN	244,919	187,048	41,061	13,936	2,874
	V	100.0	100.0	100.0	100.0	100.0
Employed Full-Time Science	N	30,655	23,665	4,982	1,682	326
	WN	202,432	156,578	32,550	11,061	2,243
	V	82.7	83.7	79.3	79.4	78.0
Employed Full-Time Nonscience	N	1,661	1,223	312	103	23
	WN	11,177	8,124	2,215	685	153
	V	4.6	4.3	5.4	4.9	5.3
Employed Part-Time Science	N	1,369	1,000	259	95	15
	WN	6,420	4,604	1,219	509	88
	V	2.6	2.5	3.0	3.7	3.1
Employed Part-Time Nonscience	N	149	111	29	8	1
	WN	760	547	155	53	5
	V	.3	.3	.4	.4	.2
Postdoctoral Appointment	N	1,018	785	192	38	3
	WN	5,958	4,604	1,136	191	27
	V	2.4	2.5	2.8	1.4	.9
Unemployed Seeking Employment	N	508	333	127	43	5
	WN	2,643	1,707	712	209	15
	V	1.1	.9	1.7	1.5	.5
Unemployed Not Seeking Employment	N	388	260	89	28	11
	WN	1,477	926	392	116	43
	V	.6	.5	1.0	.8	1.5
Retired	N	1,115	791	208	87	29
	WN	6,266	4,445	1,136	507	178
	V	2.6	2.4	2.8	3.6	6.2

APPENDIX C

NUMBER OF DOCTORAL SCIENTISTS AND ENGINEERS IN THE U.S.
BY SEX, EMPLOYMENT STATUS, AND RESPONSE GROUP
TOTAL BOTH SEXES (Continued)

1973 Employment Status		1973 Survey Response Group				
		Total Respon-dents	1st Form	2nd Form	3rd Form	4th Form
Other	N	435	295	106	28	6
	WN	2,380	1,643	568	148	21
	V	1.0	.9	1.4	1.1	.7
No Report	N	937	649	184	87	17
	WN	5,406	3,870	978	457	101
	V	2.2	2.1	2.4	3.3	3.5

N - Number of cases
WN- Weighted number of cases
V - Vertical percentage

APPENDIX C

NUMBER OF DOCTORAL SCIENTISTS AND ENGINEERS IN THE U.S. BY SEX, EMPLOYMENT STATUS, AND RESPONSE GROUP

MALE

1973 Employment Status		1973 Survey Response Group				
		Total Respondents	1st Form	2nd Form	3rd Form	4th Form
Total All	N	31,029	23,778	5,166	1,737	348
	WN	223,659	171,467	37,083	12,515	2,594
	V	100.0	100.0	100.0	100.0	100.0
Employed Full-Time Science	N	26,231	20,328	4,206	1,413	284
	WN	189,763	147,052	30,319	10,275	2,117
	V	84.8	85.8	81.8	82.1	81.6
Employed Full-Time Nonscience	N	1,314	967	249	81	17
	WN	10,141	7,374	2,013	619	135
	V	4.5	4.3	5.4	4.9	5.2
Employed Part-Time Science	N	580	424	106	44	6
	WN	3,903	2,797	728	316	62
	V	1.7	1.6	2.0	2.5	2.4
Employed Part-Time Nonscience	N	71	49	16	5	1
	WN	539	371	119	44	5
	V	.2	.2	.3	.4	.2
Postdoctoral Appointment	N	726	560	143	20	3
	WN	5,058	3,909	976	146	27
		2.3	2.3	2.6	1.2	1.0
Unemployed Seeking Employment	N	254	165	69	18	2
	WN	1,940	1,262	541	131	6
	V	.9	.7	1.5	1.0	.2
Unemployed Not Seeking Employment	N	85	51	22	9	3
	WN	591	326	172	72	21
	V	.3	.2	.5	.6	.8
Retired	N	817	580	154	65	18
	WN	5,241	3,760	944	412	125
	V	2.3	2.2	2.5	3.3	4.8

APPENDIX C

NUMBER OF DOCTORAL SCIENTISTS AND ENGINEERS IN THE U.S.
BY SEX, EMPLOYMENT STATUS, AND RESPONSE GROUP
MALE (Continued)

1973 Employment Status		1973 Survey Response Group				
		Total Respondents	1st Form	2nd Form	3rd Form	4th Form
Other	N	276	179	74	21	2
	WN	1,874	1,263	470	130	11
	V	.8	.7	1.3	1.0	.4
No Report	N	675	475	127	61	12
	WN	4,609	3,353	801	370	85
	V	2.1	2.0	2.2	3.0	3.3

APPENDIX C

NUMBER OF DOCTORAL SCIENTISTS AND ENGINEERS IN THE U.S. BY SEX, EMPLOYMENT STATUS, AND RESPONSE GROUP
FEMALE

1973 Employment Status		1973 Survey Response Group				
		Total Respondents	1st Form	2nd Form	3rd Form	4th Form
Total All	N	7,206	5,334	1,322	462	88
	WN	21,260	15,581	3,978	1,421	280
	V	100.0	100.0	100.0	100.0	100.0
Employed Full-Time Science	N	4,424	3,337	776	269	42
	WN	12,669	9,526	2,231	786	126
	V	59.6	61.1	56.1	55.3	45.0
Employed Full-Time Nonscience	N	347	256	63	22	6
	WN	1,036	750	202	66	18
	V	4.9	4.8	5.1	4.6	6.4
Employed Part-Time Science	N	789	576	153	51	9
	WN	2,517	1,807	491	193	26
	V	11.8	11.6	12.3	13.6	9.3
Employed Part-Time Nonscience	N	78	62	13	3	---
	WN	221	176	36	9	---
	V	1.0	1.1	.9	.6	---
Postdoctoral Appointment	N	292	225	49	18	---
	WN	900	695	160	45	---
	V	4.2	4.5	4.0	3.2	---
Unemployed Seeking Employment	N	254	168	58	25	3
	WN	703	445	171	78	9
	V	3.3	2.9	4.3	5.5	3.2
Unemployed Not Seeking Employment	N	303	209	67	19	8
	WN	886	600	220	44	22
	V	4.2	3.9	5.5	3.1	7.9
Retired	N	298	211	54	22	11
	WN	1,025	685	192	95	53
	V	4.8	4.4	4.8	6.7	18.9

APPENDIX C

NUMBER OF DOCTORAL SCIENTISTS AND ENGINEERS IN THE U.S.
BY SEX, EMPLOYMENT STATUS, AND RESPONSE GROUP
FEMALE (Continued)

		1973 Survey Response Group				
1973 Employment Status		Total Respondents	1st Form	2nd Form	3rd Form	4th Form
Other	N	159	116	32	7	4
	WN	506	380	98	18	10
	V	2.4	2.4	2.5	1.3	3.6
No Report	N	262	174	57	26	5
	WN	797	517	177	87	16
	V	3.7	3.3	4.4	6.1	5.7

APPENDIX D

NUMBER OF DOCTORAL SCIENTISTS AND ENGINEERS IN THE U.S.
BY SEX, TYPE OF EMPLOYER, AND RESPONSE GROUP
TOTAL BOTH SEXES

Type of Employer		1973 Survey Response Group				
		Total Respondents	1st Form	2nd Form	3rd Form	4th Form
Total All Types	N	38,235	29,112	6,488	2,199	436
	WN	244,927	187,050	41,065	13,936	2,876
	V	100.0	100.0	100.0	100.0	100.0
Business/Industry	N	6,601	5,181	1,030	321	69
	WN	50,024	39,201	7,856	2,409	558
	V	20.4	21.0	19.1	17.3	19.4
Educational Institution	N	21,463	16,343	3,642	1,249	229
	WN	132,693	100,994	22,369	7,875	1,455
	V	54.2	54.0	54.5	56.5	50.6
4 Yr. College/University	N	20,516	15,620	3,475	1,202	219
	WN	128,095	97,470	21,597	7,623	1,405
	V	52.3	52.1	52.6	54.7	48.9
Junior College	N	597	456	101	35	5
	WN	3,061	2,366	465	210	20
	V	1.2	1.3	1.1	1.5	.7
Elementary/Secondary School	N	350	267	66	12	5
	WN	1,537	1,158	307	42	30
	V	.6	.6	.7	.3	1.0
Hospital and Clinic	N	996	767	156	66	7
	WN	5,713	4,425	865	386	37
	V	2.3	2.4	2.1	2.8	1.3
Nonprofit Organization	N	1,164	913	186	56	9
	WN	7,854	6,144	1,262	378	70
	V	3.2	3.3	3.1	2.7	2.4
Federal Government	N	2,608	2,097	376	109	26
	WN	17,641	14,193	2,580	680	188
	V	7.2	7.6	6.3	4.9	6.5

APPENDIX D

NUMBER OF DOCTORAL SCIENTISTS AND ENGINEERS IN THE U.S.,
BY SEX, TYPE OF EMPLOYER, AND RESPONSE GROUP
TOTAL BOTH SEXES (Continued)

Type of Employer		1973 Survey Response Group				
		Total Respon-dents	1st Form	2nd Form	3rd Form	4th Form
Military/Commissioned Corps	N	272	219	43	8	2
	WN	1,984	1,606	309	48	21
	V	.8	.9	.8	.3	.7
State Government	N	414	319	70	24	1
	WN	2,597	2,062	396	133	6
	V	1.1	1.1	1.0	[illegible]	.2
Other Government/ International Agency	N	214	156	47	8	3
	WN	1,323	953	285	54	31
	V	.5	.5	.7	.4	1.1
Other	N	530	378	105	35	12
	WN	3,390	2,410	654	230	96
	V	1.4	1.3	1.6	1.7	3.3
Not Employed	N	3,383	2,328	714	273	68
	WN	18,172	12,592	3,786	1,436	358
	V	7.4	6.7	9.2	10.3	12.4
No Report	N	590	411	119	50	10
	WN	3,536	2,470	703	307	56

N - Number of cases
WN - Weighted number of cases
V - Vertical percentage

APPENDIX D

NUMBER OF DOCTORAL SCIENTISTS AND ENGINEERS IN THE U.S.
BY SEX, TYPE OF EMPLOYER, AND RESPONSE GROUP
MALE

Type of Employer		1973 Survey Response Group				
		Total Respon-dents	1st Form	2nd Form	3rd Form	4th Form
Total All Types	N	31,029	23,778	5,166	1,737	348
	WN	223,664	171,469	37,085	12,515	2,595
	V	100.0	100.0	100.0	100.0	100.0
Business/Industry	N	6,261	4,926	969	298	68
	WN	49,132	38,530	7,701	2,345	556
	V	22.0	22.5	20.8	18.7	21.4
Educational Institution	N	17,187	13,096	2,908	999	184
	WN	120,434	91,731	20,237	7,136	1,330
	V	53.8	53.5	54.6	57.0	51.3
4 Yr. College/University	N	16,634	12,676	2,813	967	178
	WN	116,903	89,019	19,662	6,934	1,288
	V	52.3	51.9	53.0	55.4	49.6
Junior College	N	387	296	60	28	3
	WN	2,477	1,935	352	174	16
	V	1.1	1.1	.9	1.4	.6
Elementary/Secondary School	N	166	124	35	4	3
	WN	1,054	777	223	28	26
	V	.5	.5	.6	.2	1.0
Hospital and Clinic	N	678	542	90	40	6
	WN	4,542	3,623	610	276	33
	V	2.0	2.1	1.6	2.2	1.3
Nonprofit Organization	N	933	742	145	40	6
	WN	7,130	5,621	1,122	330	57
	V	3.2	3.3	3.0	2.6	2.2
Federal Government	N	2,292	1,847	330	92	23
	WN	16,791	13,525	2,455	633	178
	V	7.5	7.9	6.6	5.1	6.9

APPENDIX D

NUMBER OF DOCTORAL SCIENTISTS AND ENGINEERS IN THE U.S.
BY SEX, TYPE OF EMPLOYER, AND RESPONSE GROUP
MALE (Continued)

Type of Employer		1973 Survey Response Group				
		Total Respondents	1st Form	2nd Form	3rd Form	4th Form
Military/Commissioned Corps	N	262	211	42	7	2
	WN	1,962	1,587	307	47	21
	V	.9	.9	.8	.4	.8
State Government	N	330	260	53	17	---
	WN	2,319	1,849	357	113	---
	V	1.0	1.1	1.0	.9	---
Other Government/ International Agency	N	153	110	34	6	3
	WN	1,124	806	240	47	31
	V	.5	.5	.6	.4	1.2
Other	N	386	280	69	26	11
	WN	2,945	2,096	552	209	88
	V	1.3	1.2	1.5	1.7	3.4
Not Employed	N	2,107	1,450	446	174	37
	WN	14,255	9,965	2,928	1,114	248
	V	6.4	5.8	7.9	8.9	9.6
No Report	N	440	314	80	38	8
	WN	3,030	2,136	576	265	53

APPENDIX D

NUMBER OF DOCTORAL SCIENTISTS AND ENGINEERS IN THE U.S.
BY SEX, TYPE OF EMPLOYER, AND RESPONSE GROUP
FEMALE

Type of Employer		1973 Survey Response Group				
		Total Respon-dents	1st Form	2nd Form	3rd Form	4th Form
Total All Types	N	7,206	5,334	1,322	462	88
	WN	21,263	15,581	3,980	1,421	281
	V	100.0	100.0	100.0	100.0	100.0
Business/Industry	N	340	255	61	23	1
	WN	892	671	155	64	2
	V	4.2	4.3	3.9	4.5	.7
Educational Institution	N	4,276	3,247	734	250	45
	WN	12,259	9,263	2,132	739	125
	V	57.7	59.5	53.6	52.0	44.5
4 Yr. College/University	N	3,882	2,944	662	235	41
	WN	11,192	8,451	1,935	689	117
	V	52.6	54.2	48.6	48.5	41.6
Junior College	N	210	160	41	7	2
	WN	584	431	113	36	4
	V	2.7	2.8	2.8	2.5	1.4
Elementary/Secondary School	N	184	143	31	8	2
	WN	483	381	84	14	4
	V	2.3	2.4	2.1	1.0	1.4
Hospital and Clinic	N	318	225	66	26	1
	WN	1,171	802	255	110	4
	V	5.5	5.1	6.4	7.7	1.4
Nonprofit Organization	N	231	171	41	16	3
	WN	724	523	140	48	13
	V	3.4	3.4	3.5	3.4	4.6
Federal Government	N	316	250	46	17	3
	WN	850	668	125	47	10
	V	4.0	4.3	3.1	3.3	3.6

APPENDIX D

NUMBER OF DOCTORAL SCIENTISTS AND ENGINEERS IN THE U.S.
BY SEX, TYPE OF EMPLOYER, AND RESPONSE GROUP
FEMALE (Continued)

Type of Employer		Total Respondents	1973 Survey Response Group: 1st Form	2nd Form	3rd Form	4th Form
Military/Commissioned Corps	N	10	8	1	1	---
	WN	22	19	2	1	---
	V	.1	.1	.1	.1	---
State Government	N	84	59	17	7	1
	WN	278	213	39	20	6
	V	1.3	1.4	1.0	1.4	2.1
Other Government/ International Agency	N	61	46	13	2	---
	WN	199	147	45	7	---
	V	.9	.9	1.1	.5	---
Other	N	144	98	36	9	1
	WN	445	314	102	21	8
	V	2.1	2.0	2.6	1.5	2.8
Not Employed	N	1,276	878	268	99	31
	WN	3,917	2,627	858	322	110
	V	18.4	16.9	21.6	22.7	39.1
No Report	N	150	97	39	12	2
	WN	506	334	127	42	3

APPENDIX E

MEDIAN ANNUAL SALARIES OF DOCTORAL SCIENTISTS AND ENGINEERS
FULL-FIME EMPLOYED IN THE U.S. BY SEX AND RESPONSE GROUP
TOTAL BOTH SEXES

1973 Salary		1973 Survey Response Group				
		Total Respon-dents	1st Form	2nd Form	3rd Form	4th Form
Less than $5,000	N	109	76	24	8	1
	WN	565	398	126	31	10
$5,000-9,999	N	289	217	59	11	2
	WN	1,543	1,115	361	64	3
$10,000-14,999	N	3,315	2,567	548	177	23
	WN	20,353	15,744	3,426	1,049	134
$15,000-19,999	N	9,936	7,657	1,594	563	122
	WN	65,196	50,406	10,310	3,661	819
$20,000-24,999	N	8,374	6,488	1,319	472	95
	WN	55,977	43,466	8,722	3,090	699
$25,000-29,999	N	4,114	3,189	670	215	40
	WN	28,114	21,729	4,587	1,521	277
$30,000-34,999	N	1,997	1,528	339	113	17
	WN	13,684	10,444	2,339	761	140
$35,000-39,999	N	914	710	143	51	10
	WN	6,172	4,878	894	347	53
$40,000-44,999	N	290	222	42	18	8
	WN	2,123	1,647	305	120	51
$45,000-49,999	N	106	83	14	9	---
	WN	820	643	106	71	---
Greater than $50,000	N	238	172	42	23	1
	WN	1,744	1,270	294	175	5
Not Reported	N	2,634	1,979	500	125	30
	WN	17,322	12,962	3,298	856	206
Total Full-Time Employed	N	32,316	24,888	5,294	1,785	349
	WN	213,613	164,702	34,768	11,746	2,397
Median		20,887	20,894	20,817	20,986	20,876

APPENDIX E

MEDIAN ANNUAL SALARIES OF DOCTORAL SCIENTISTS AND ENGINEERS FULL-TIME EMPLOYED IN THE U.S. BY SEX AND RESPONSE GROUP

MALE

1973 Salary		1973 Survey Response Group				
		Total Respondents	1st Form	2nd Form	3rd Form	4th Form
Less than $5,000	N	59	41	14	3	1
	WN	450	322	97	21	10
$5,000-9,999	N	166	120	38	8	---
	WN	1,184	822	303	59	---
$10,000-14,999	N	2,279	1,768	381	115	15
	WN	17,413	13,513	2,934	865	101
$15,000-19,999	N	8,091	6,270	1,271	449	101
	WN	59,810	46,380	9,333	3,336	761
$20,000-24,999	N	7,466	5,818	1,154	410	84
	WN	53,481	41,642	8,275	2,900	664
$25,000-29,999	N	3,824	2,976	621	191	36
	WN	27,272	21,105	4,464	1,439	264
$30,000-34,999	N	1,898	1,452	322	107	17
	WN	13,375	10,215	2,277	743	140
$35,000-39,999	N	884	692	132	50	10
	WN	6,093	4,825	871	344	53
$40,000-44,999	N	282	215	41	18	8
	WN	2,089	1,618	300	120	51
$45,000-49,999	N	104	81	14	9	---
	WN	817	640	106	71	---
Greater than $50,000	N	234	171	39	23	1
	WN	1,728	1,269	279	175	5
Not Reported	N	2,258	1,691	428	111	28
	WN	16,191	12,074	3,094	820	203
Total Full-Time Employed	N	27,545	21,295	4,455	1,494	301
	WN	199,903	154,425	32,333	10,893	2,252
Median		21,165	21,167	21,130	21,253	21,098

APPENDIX E

MEDIAN ANNUAL SALARIES OF DOCTORAL SCIENTISTS AND ENGINEERS FULL-TIME EMPLOYED IN THE U.S. BY SEX AND RESPONSE GROUP
FEMALE

1973 Salary		Total Respondents	1973 Survey Response Group 1st Form	2nd Form	3rd Form	4th Form
Less than $5,000	N	50	35	10	5	---
	WN	115	76	29	10	---
$5,000-9,999	N	123	97	21	3	2
	WN	359	293	58	5	3
$10,000-14,999	N	1,036	799	167	62	8
	WN	2,940	2,231	492	184	33
$15,000-19,999	N	1,845	1,387	323	114	21
	WN	5,386	4,026	977	325	58
$20,000-24,999	N	908	670	165	62	11
	WN	2,496	1,824	447	190	35
$25,000-$29,999	N	290	213	49	24	4
	WN	842	624	123	82	13
$30,000-34,999	N	99	76	17	6	---
	WN	309	229	62	18	---
$35,000-39,999	N	30	18	11	1	---
	WN	79	53	23	3	---
$40,000-44,999	N	8	7	1	---	---
	WN	34	29	5	---	---
$45,000-49,999	N	2	2	---	---	---
	WN	3	3	---	---	---
Greater than $50,000	N	4	1	3	---	---
	WN	16	1	15	---	---
Not Reported	N	376	288	72	14	2
	WN	1,131	888	204	36	3
Total Full-Time Employed	N	4,771	3,593	839	291	48
	WN	13,710	10,277	2,435	853	145
Median		17,619	17,551	17,696	18,173	17,967

APPENDIX F

FOREIGN PH.D./U.S. PH.D. RATIO IN THE 1973 SAMPLE

Year of Ph.D.	A U.S. Ph.D. in Sample	B Foreign Ph.D. in Sample	C Foreign/U.S.
1930-35	2030	363	.18
1936-41	2416	371	.15
1942-45	1552	221	.14
1946-49	2032	324	.16
1950-53	3806	460	.12
1954-57	4333	514	.12
1958-61	5130	603	.12
1962-63	4243	452	.11
1964-65	4987	501	.10
1966-67	5737	507	.09
1968-69	6566	412	.06
1970-71	7358	123	.02
1972	3690	9	<.01
Unknown	--	346	--
Total	53880	5206	.10

APPENDIX G

U.S. NONSCIENCE PH.D.'S EMPLOYED IN SCIENCE IN 1973

Ph.D. Year	Total Science-Employed	U.S. Nonscience Ph.D.'s	
		Number	Percent
Pre-1962	79,471	2,768	3.5
1962	6,832	344	5.0
1963	7,810	269	3.4
1964	8,915	426	4.8
1965	9,723	488	5.0
1966	11,050	601	5.4
1967	11,857	550	4.6
1968	13,346	627	4.7
1969	14,905	570	3.8
1970	15,688	599	3.8
1971	16,507	487	3.0
1972	16,221	40	---
Unknown	76	---	---
TOTAL	212,401	7,769	3.7