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STUDY II OF SCIENTISTS AND ENGINEERS IN THE DoD LABORATORIES

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July 1990

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Office of the Under Secretary of Defense for Acquisition
(Deputy Director of Defense Research and Engineering)

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13. ABSTRACT *(Maximum 200 words)*

This study of scientists and engineers in DoD laboratories updates a study conducted in 1981. The primary objective is to identify trends in the recruitment and retention of scientists and engineers since 1981. The principal sources of data are questionnaires completed by the management of 66 DoD laboratories in 1986 and personnel and pay data from the Defense Manpower Data Center, and governmental and non-government organizations for 1986, 1987, 1988. Particular attention is given to the comparability of pay of scientists and engineers in the DoD laboratories and in industrial organizations.

A pay gap that favors national scientists and engineers over those in the DoD laboratories is found when these groups are compared by level of responsibility and by level of experience (years since receiving bachelor's degree). However, engineers in the DoD laboratories are more heavily concentrated at higher levels of responsibility than engineers in industry; and scientists and engineers in the DoD laboratories have, on average, more experience than those in industry. The pay gap is even wider for scientists and engineers with advanced degrees, for scientists and engineers who are supervisors, and for scientists and engineers who are superior performers as indicated by percentile salaries.

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FOREWORD

In the summer of 1986, the Research and Laboratory Management (R&LM) Directorate of the Office of the Deputy Director of Defense Research and Engineering (Research and Advanced Technology) in the Department of Defense initiated a two-part study of scientists and engineers (S&E). The objective of Part l was to examine the state in 1986 of S&E in the DoD laboratories ("labs") using a 1981 "Study of Scientists and Engineers in the DoD Laboratories" as our study model. The objective of Part 2 was to design and perform an analysis of the quality of S&E who are employed throughout the DoD.

The study was assigned to the Institute for Defense Analyses (IDA). Principal analytical efforts were performed by The Analytic Sciences Corporation (now known as TASC) to support the study of DoD lab S&E and by the Allen Corporation of America (now known as Link Training Services Division of the CAE-Link Corporation) to support the study of DoD-wide S&E.

During the course of the study, a panel composed of representatives of the Services and of the Office of the Secretary of Defense provided advice to IDA, TASC, and Link analysts. The R&LM Directorate was represented by Jeanne Carney, initiator of the two-part study, and Neal Glassman, who worked in the R&LM Directorate on loan from the Office of Naval Research while Ms. Carney took a sabbatical leave at the National Defense University. Service panel members included Robert Sasmor of the Army's Laboratory Command, Don DeYoung of the Naval Research Laboratory, and Stanley Dickinson of the Directorate of Science and Technology of U.S. Air Force Headquarters. Panel members from the Office of the Assistant Secretary of Defense (Force Management and Personnel) included personnel management specialists Thomas Hatheway and Earl Payne and labor economist Larry Lacy. The advisory panel also included, as a consultant, Herbert Rabin, who was the project leader of the earlier DoD lab S&E study and who is now Director of the Engineering Research Center of the University of Maryland.

Michal Bohn and Eleanor Feldbaum of TASC collected survey data from the DoD labs, reduced that data to tables and graphs, and produced an initial draft of this report. A report of the analysis of DoD-wide S&E is issued separately.

The studies of S&E in the labs and in the entire DoD were done concurrently but at different paces. A questionnaire-survey of the labs was conducted while a survey of individual S&E throughout DoD was being formulated. Data from the lab survey were analyzed while the DoD-wide survey was conducted. A dedicated telephone line was available in the latter survey for individual S&E to ask questions about the study or the questionnaire. Discussions with numerous callers, who were among the more-than-23,000 S&E randomly selected for the survey, and responses from the lab survey confirmed feelings by this study's authors and advisors that comparability of pay of DoD lab S&E and national S&E was a major--if not *the* major--issue. Thus, we gave pay comparability more attention than we had expected in planning the lab survey and analysis. The issue of pay comparability and the examination of the influence of pay on recruitment and retention led us to use data for more recent years, 1987 and 1988, as well as for the years, 1981 and 1986, being compared. We considered S&E salary data from several sources: the National Science Foundation, the U.S. Bureau of Labor Statistics, the U.S. Department of Energy, the Engineering Manpower Commission of the American Association of Engineering Societies, the American Institute of Physics, the Institute of Electrical and Electronics Engineering, and the National Society of Professional Engineers.

The Defense Manpower Data Center was a major contributor to the study effort. The authors and advisors join in thanking Michael Dove, Deborah Eitelberg, Margaret Lazanoff, and D. Richard McGonigal of DMDC Monterey for their advice, analytical assistance, and programming support. Their quick responses to our numerous data requests and their cooperative, helpful attitudes are genuinely appreciated by all of us.

And we thank reviewers Alan Fechter of the National Research Council and Ronald Finkler and William Schultis of IDA for critically examining our data tabulations, graphs, and bar charts and for their suggestions that improved contents of the report and the explanatory material.

Findings of this study were provided to our sponsor and advisors as they became available. Publication of this report was delayed for administrative reasons and for several revisions made to clarify interpretation of the data.

CONTENTS

CHARTS

ABBREVIATIONS

AF	Air Force
AIP	American Institute of Physics
B	billion
BLS	Bureau of Labor Statistics
CSRS	Civil Service Retirement System
CY	calendar year
DMDC	Defense Manpower Data Center
DoD	Department of Defense
DOE	Department of Energy
EE	electrical and electronics engineering (or engineers)
EMC	Engineering Manpower Commission
FERS	Federal Employees' Retirement System
FY	fiscal year
GS	General Schedule
IEEE	Institute of Electrical and Electronics Engineers
K	thousand
LOS	length of service
NSF	National Science Foundation
NSPE	National Society of Professional Engineers
PL	public law

R&D	research and development
R&LM	Research and Laboratory Management
SES	Senior Executive Service
S&E	scientists and engineers
TSP	Thrift Savings Plan
YSB	years since baccalaureate

EXECUTIVE SUMMARY

I. INTRODUCTION

The purpose of this study is to provide a basis for actions, by the Office of the Secretary of Defense and/or the Services, to aid the DoD Laboratories ("labs") in recruiting and retaining scientists and engineers ("S&E"). This study was sponsored by the Research and Laboratory Management Directorate of the Office of the Director of Defense Research and Engineering.

Our procedure was to collect 1986 data on 25,000 civilian S&E in 66 DoD labs, in much the same manner as was done in a similar study five years earlier, in order to identify and evaluate significant trends in this population. Our specific concern was to analyze S&E recruitment and retention, which were the primary foci of the 1981 study. That analysis uses 1987 and 1988 data as well as data for the 1981 and 1986 comparative years. For purpose of comparison we used the same occupational structure that was used in the previous study: 67 job codes for scientists and 22 for engineers (for details, see Chart I-1 in the report).

This two-part summary first describes our analysis of recruitment and retention. The second part summarizes the findings from all the study material, which was divided into eight topical chapters: (1) S&E workforce, (2) S&E help wanted, (3) recruitment, (4) retention, (5) training, (6) Senior Executive Service, (7) pay, and (9) benefits. The latter two topics are especially relevant to recruitment and retention. The other topics were addressed in the earlier study and help to describe the lab system in which we examine recruitment and retention.

As our principal sources of data, we used survey questionnaires, which were sent to the directors of each of the 66 labs--35 Army, 20 Navy, and 11 Air Force--and personnel data files of the Defense Manpower Data Center (DMDC), whose data on lab S&E originate in the labs--and are submitted to DMDC via Service personnel-reporting channels.

II. ANALYSIS OF RECRUITMENT AND RETENTION

A. PAY

Lab directors say that low salaries and benefits are their most important lab problem (see Chart V-24[1]). Low pay is the top reason S&E decline lab jobs (Chart IV-13). And low pay is the top reason S&E resign from the labs (Charts V-14 and -15). Thus, the comparability of pay of lab S&E and national S&E is a logical place to start our analysis.

Pay comparisons have to be considered with an awareness that composition of the lab S&E group and the comparable national S&E group may differ by an unknown extent both in the disciplines included and their relative representation. The pay comparability problem is further aggravated when salary data for national S&E groups come from professional societies whose memberships include non-S&E.

Our pay comparability analysis uses data from salary surveys of national S&E groups most similar to lab S&E. We exclude from pay comparisons in this analysis any survey data bases that utilize self-reporting for salaries (but several such data bases are reported separately.

Salary data from U.S. Bureau of Labor Statistics (BLS) surveys are suitable since they apply to national engineers, whose proportions with bachelor's, master's, and doctor's degrees are about the same as those for lab *engineers*, and who are distributed by a level-of-responsibility hierarchical system that is modeled after and equivalent to the General Schedule grade-level system of the Civil Service. Similarly, salary data from Engineering Manpower Commission (EMC) surveys enable us to make pay comparisons for lab *engineers* and national engineers employed by industry, with both groups distributed by education level and experience, i.e.,years since baccalaureate. And salary data from U.S. Department of Energy (DOE) surveys are useful because they apply to *scientists and engineers* who work in R&D establishments and who also are bivariately distributed by

1 All Roman-numerated charts are found in the correspondingly numbered chapters of the main report. Charts in the Executive Summary contain "S" prefixes.

education level and years since baccalaureate. In their surveys, the BLS, the EMC, and the DOE collect salary data from organizations' payroll records and not from individual self reports.

1. Pay Gap

Our analysis of pay comparability indicates that a disparity in the pay of national S&E and DoD lab S&E--a workforce that is 36 percent scientists and 64 percent engineers--does indeed exist. The pay gap, favoring national S&E over DoD lab S&E exists for S&E distributed by levels of responsibility, by education level, by number of years since baccalaureate, or by supervisory responsibility. And the gap is wider, as indicated by percentile salaries, for S&E with advanced degrees, for S&E who are supervisors, and for S&E who are superior performers.

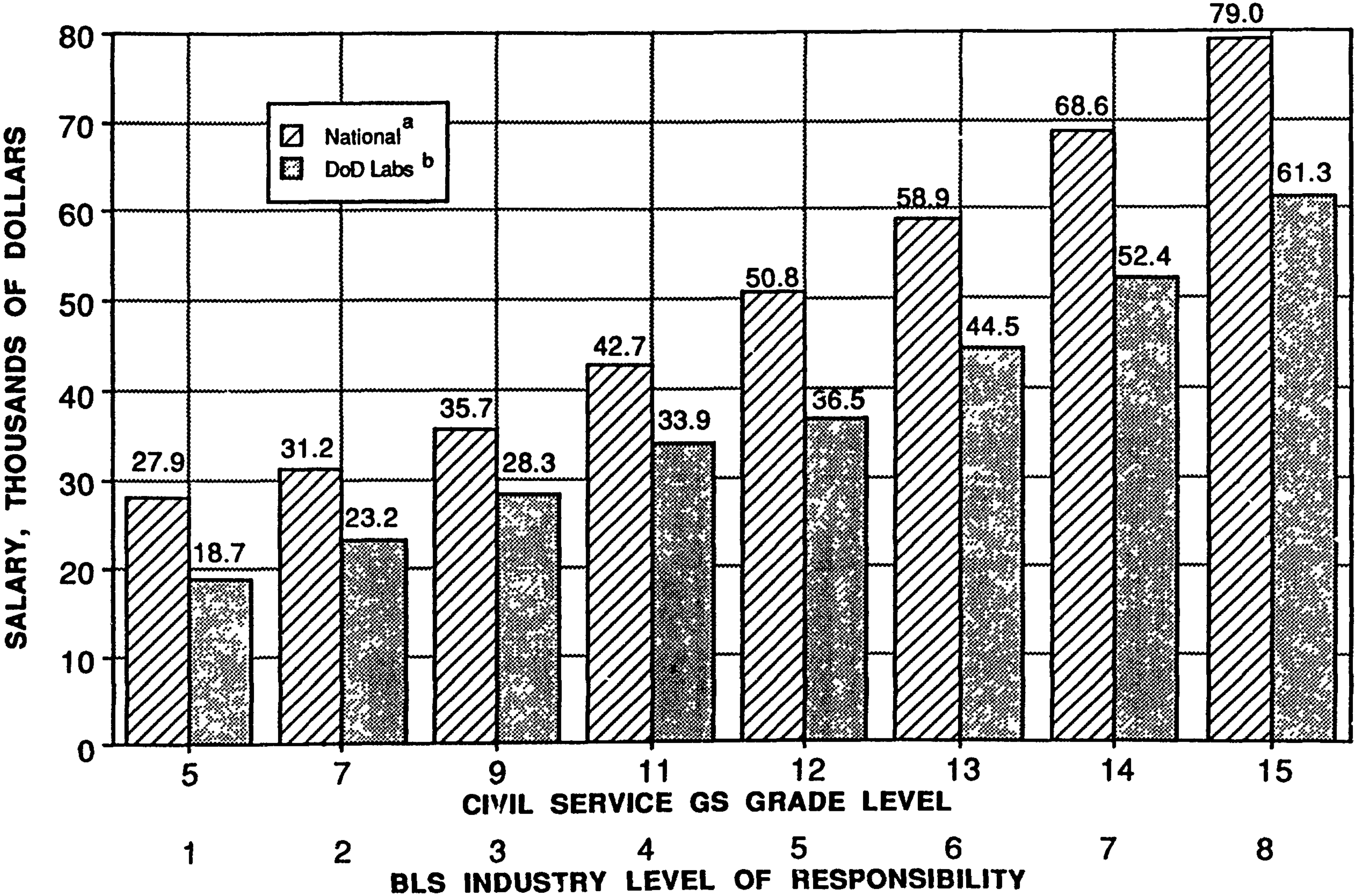
In Chart S-1 we see that grade level 5 DoD lab engineers were paid $9K less in 1986 than national engineers at the corresponding level of responsibility. Similarly GS-7, -9, and -11 lab engineers were paid $8K, $7K, and $9K less, respectively, than equivalent-level national engineers. And GS-12 through GS-15 engineers in the labs were paid $14K to $18K less than national engineers at corresponding levels of responsibility.

a. Engineers

In parts A of Charts S-2, S-3, and S-4, we compare 1987 salaries of *nonsupervisory* engineers--in the labs and in industry--with bachelor's, master's, and doctor's degrees, respectively (data sources are Charts VIII-60, -61, and -62). We see that for the same experience level, years since baccalaureate, the comparisons almost invariably favor engineers in industry throughout their careers, and the comparisons are increasingly favorable to industry as we step up from bachelor's-, to master's-, and to doctor's-degree levels of education (salary comparisons are not shown for any years-since-baccalaureate category in which the DoD lab population is less than 10).

Chart S-2 shows that, following an entry-level pay difference of about $5K, the yearly pay gap narrows to $1.5K or less (the comparisons slightly favor lab engineers after 23 years since baccalaureate) throughout the careers of bachelor's-degree level engineers, who represent 70 percent of all nonsupervisory engineers in the labs and 71 percent of nonsupervisory engineers in industry.

CHART S-1. SALARIES OF ENGINEERS DISTRIBUTED BY LEVEL OF RESPONSIBILITY IN 1986



[a] Source: Bureau of Labor Statistics (Ref. 14).
[b] Source: DMDC.

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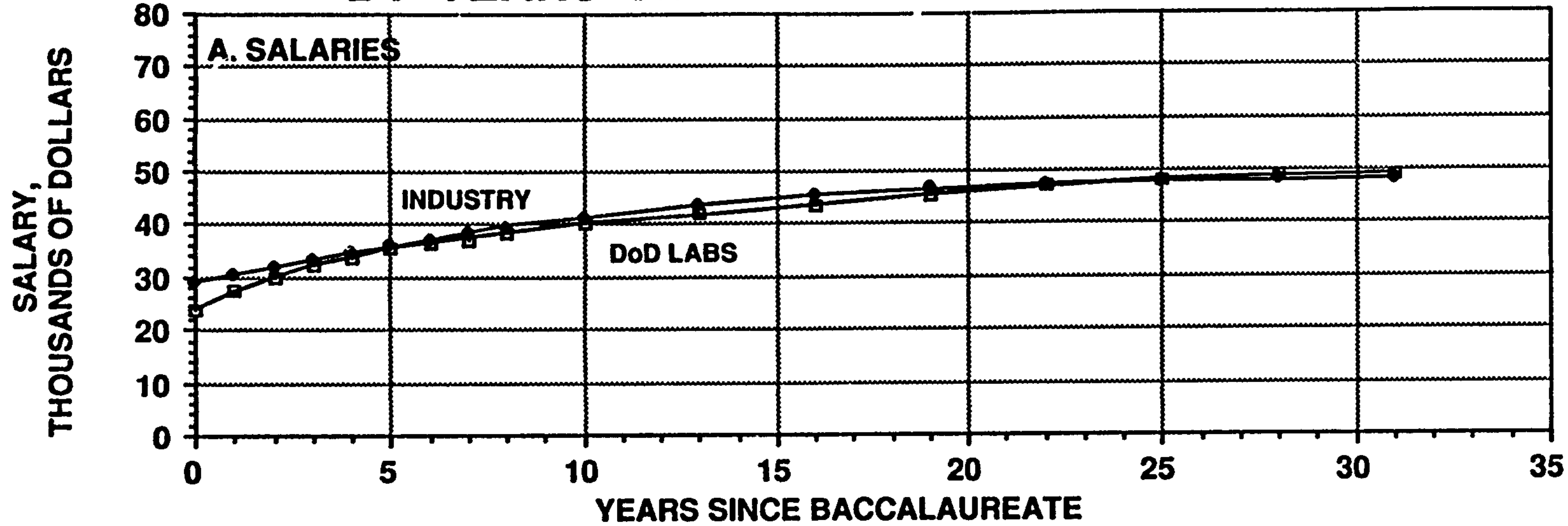
CHART S-2. 1987 SALARIES OF NONSUPERVISORY ENGINEERS, AT THE BACHELOR'S DEGREE LEVEL, DISTRIBUTED BY YEARS SINCE BACCALAUREATE



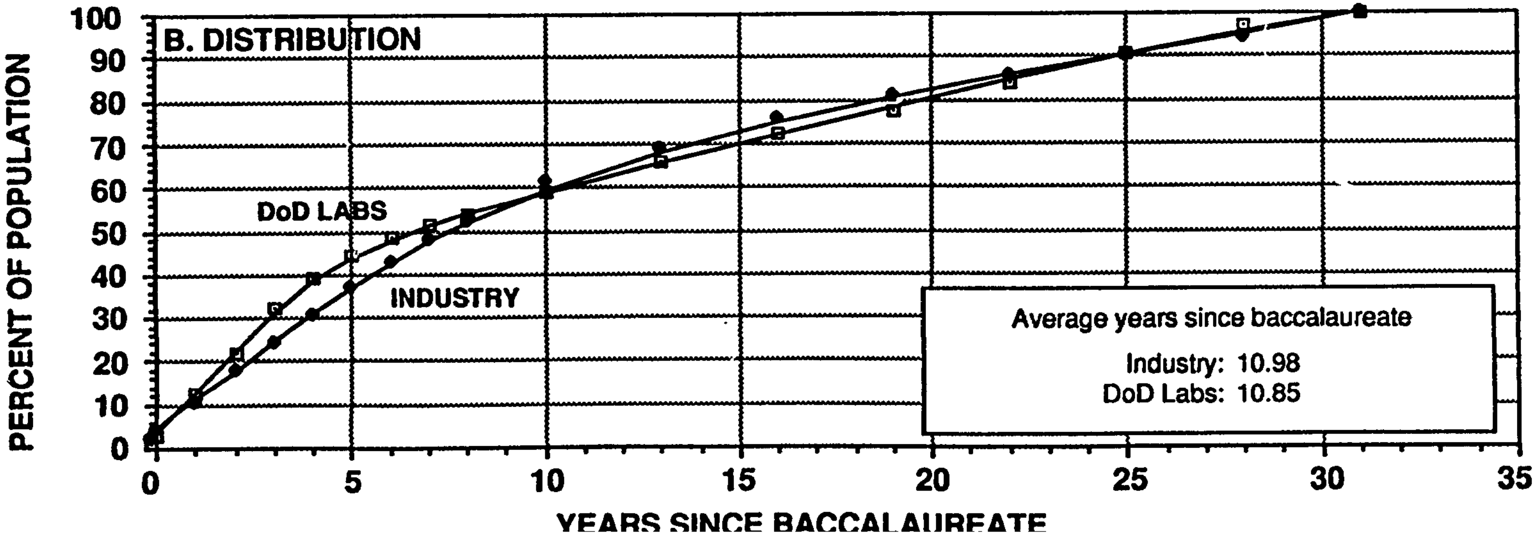
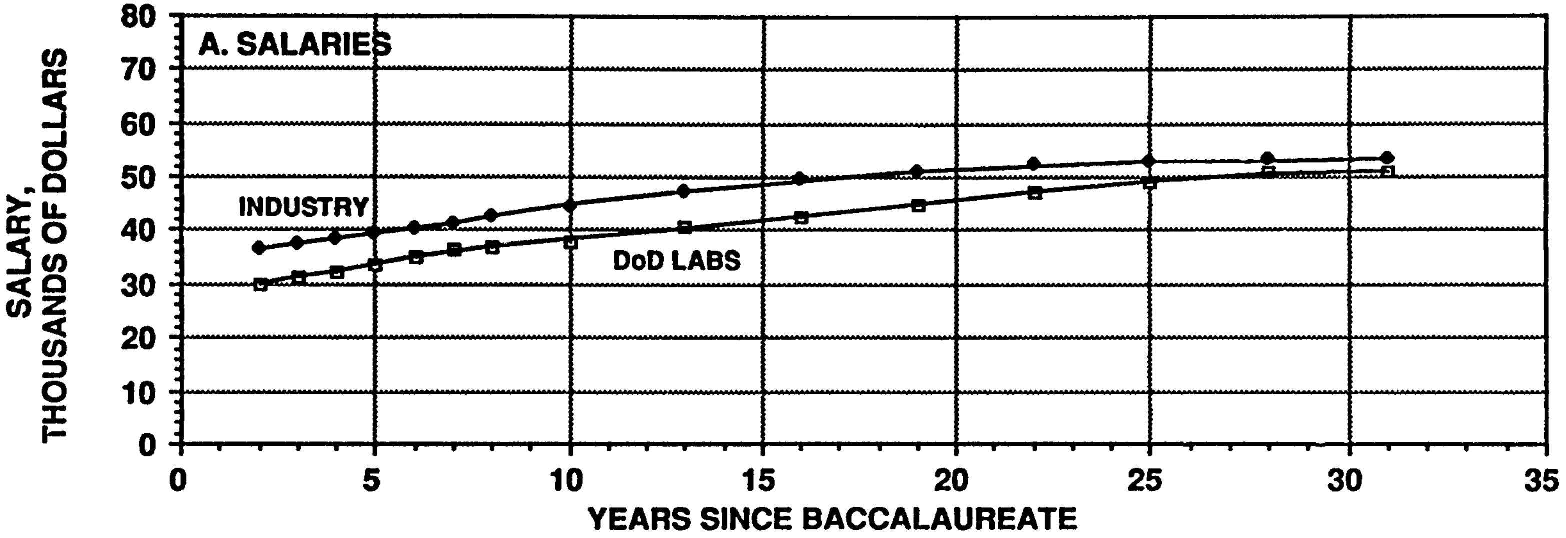


CHART S-3. 1987 SALARIES OF NONSUPERVISORY ENGINEERS, AT THE MASTER'S DEGREE LEVEL, DISTRIBUTED BY YEARS SINCE BACCALAUREATE



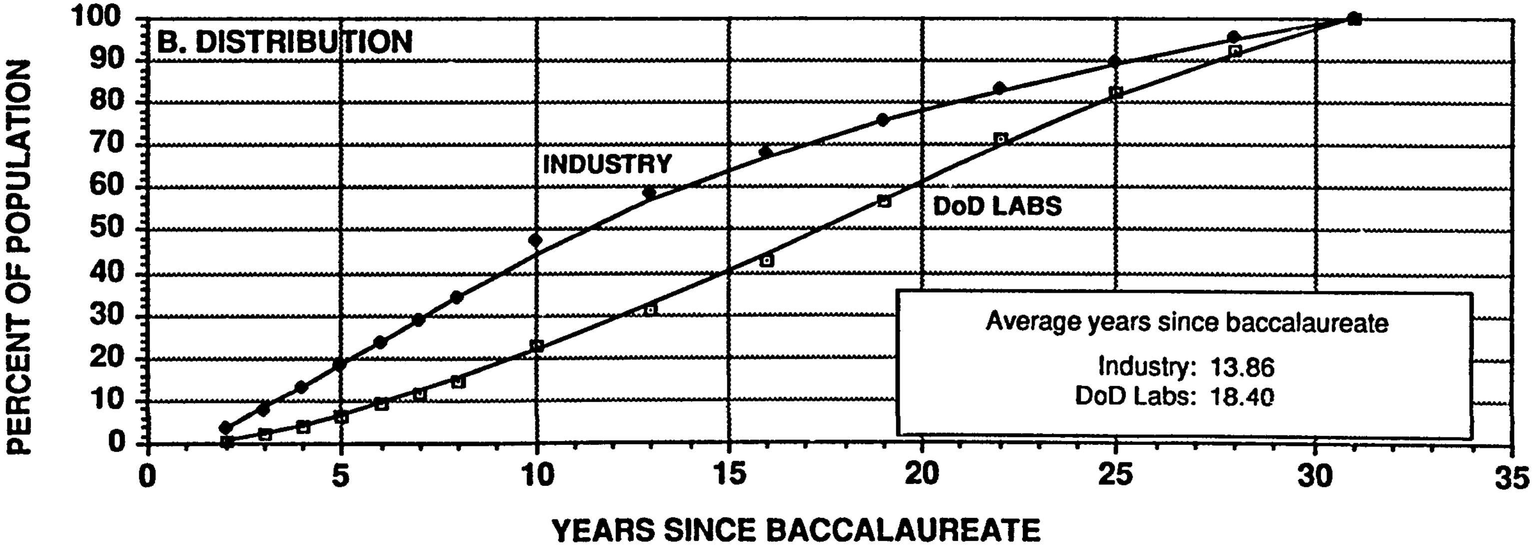
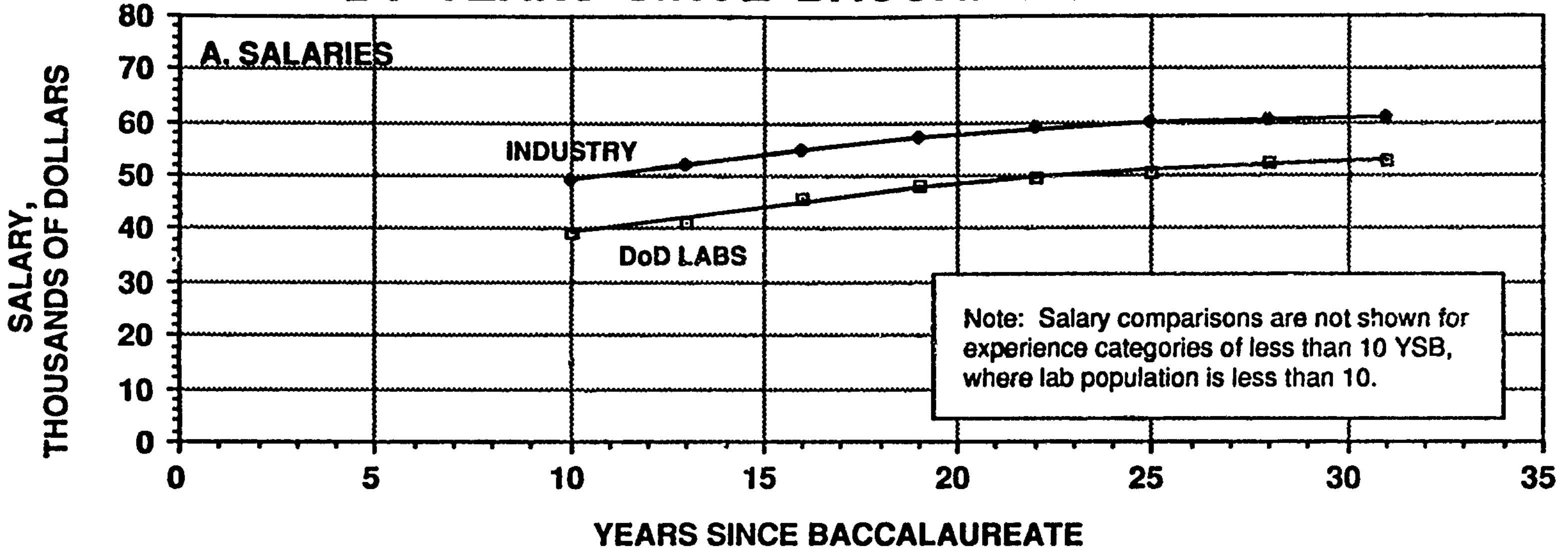


CHART S-4. 1987 SALARIES OF NONSUPERVISORY ENGINEERS, AT THE DOCTOR'S DEGREE LEVEL, DISTRIBUTED BY YEARS SINCE BACCALAUREATE



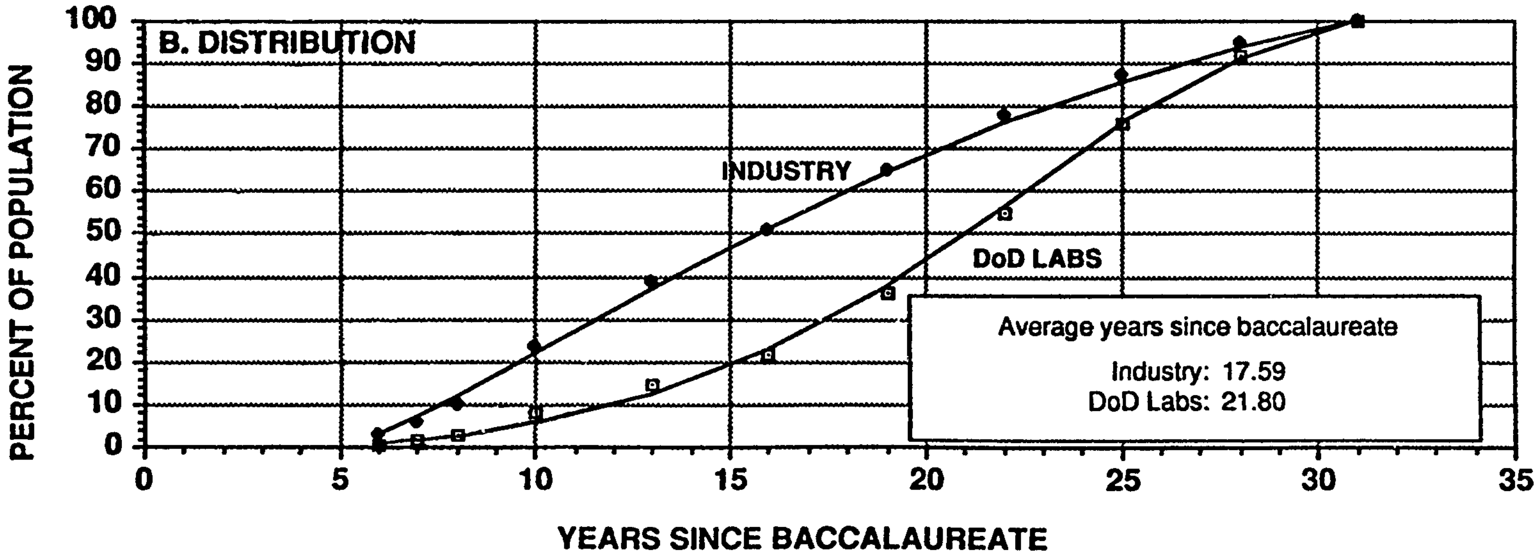


Chart S-3 shows yearly pay differences on the order of $5K to $6K during most of the careers of master's-degree level engineers, who make up 25 percent of nonsupervisory engineers in the labs and 23 percent of nonsupervisory engineers in industry.

Chart S-4 indicates that engineers with doctorates in industry are about $9K per year better paid than their lab counterparts; five percent of nonsupervisory engineers in the labs and seven percent in industry hold doctor's degrees.

Parts A of Charts S-5, S-6, and S-7 show for *supervisory* engineers salary comparisons similar to those for nonsupervisory engineers in the three preceding charts (data sources are Charts VIII-65, -66, and-67). Here also, comparisons for the same number of years since baccalaureate favor engineers in industry and increasingly so as we step to higher education levels (and, as in the preceding charts, salary comparisons are not shown for any years-since-baccalaureate category in which the lab population is less than 10). In the DoD labs, 53 percent of supervisory engineers are at the bachelor's-degree level, 37 percent master's degree, and 20 percent doctor's degree; the corresponding breakdown for engineers in industry is 64 percent, 38 percent, and eight percent.

In Chart S-5 for supervisory engineers with bachelor's degrees, we see that pay differences unfavorable to lab engineers grow from about $2K at 10 years since baccalaureate (YSB) to $6K at 20 YSB and narrow to $3K at 31 YSB.

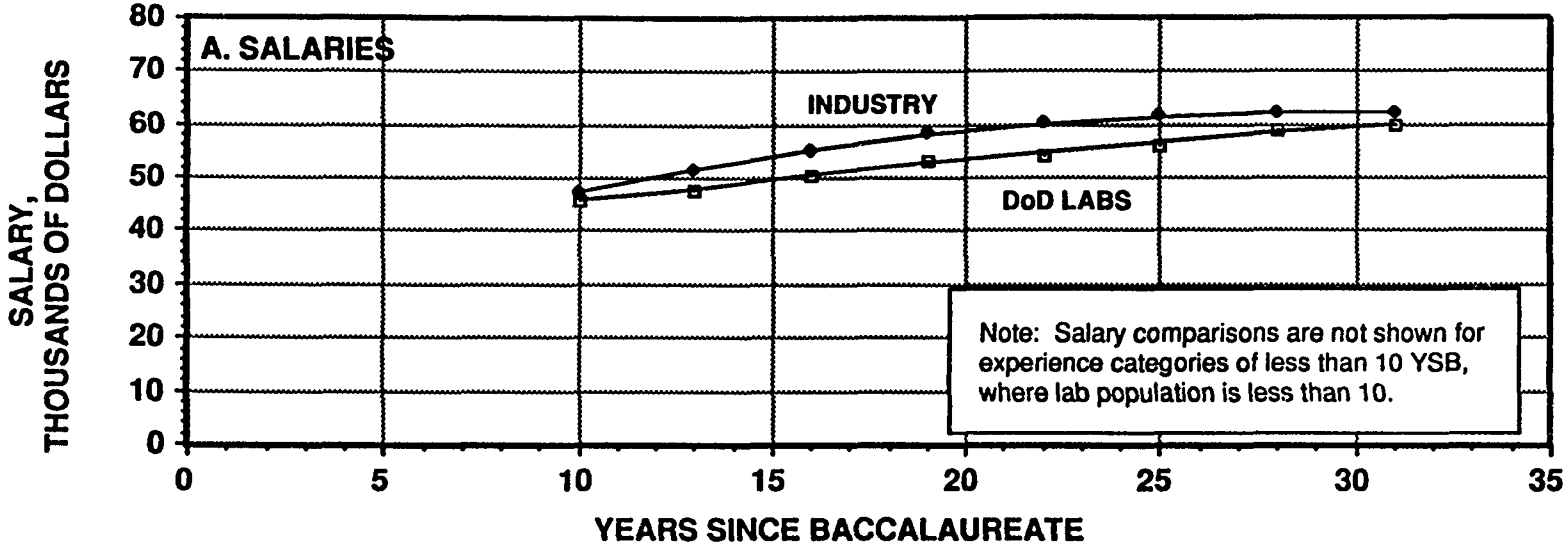
For supervisory engineers with master's degrees, Chart S-6 shows pay gaps favorable to industry by $12K per year over a broad range of YSB and narrowing to $9K at 30 YSB.

The pay gaps favoring industry in Chart S-7 are even wider--$13K to $14K over a broad range of YSB--for supervisory engineers with doctorates.

b. Scientists and Engineers

In parts A of Charts S-8, S-9, and S-10, we compare 1987 salaries of *nonsupervisory* S&E--in the DoD labs and in R&D establishments in industry--with bachelor's, master's, and doctor's degrees, respectively (data sources are Charts VIII-33, -34, and -35). As in the case of engineers only, we see that for the same number of years since baccalaureate the comparisons favor S&E in industry, and the comparisons increasingly favor industry as we consider higher education levels (salary comparisons are not shown for any years-since-baccalaureate category in which the DoD lab population is less than 10).

CHART S-5. 1987 SALARIES OF SUPERVISORY ENGINEERS, AT THE BACHELOR'S DEGREE LEVEL, DISTRIBUTED BY YEARS SINCE BACCALAUREATE



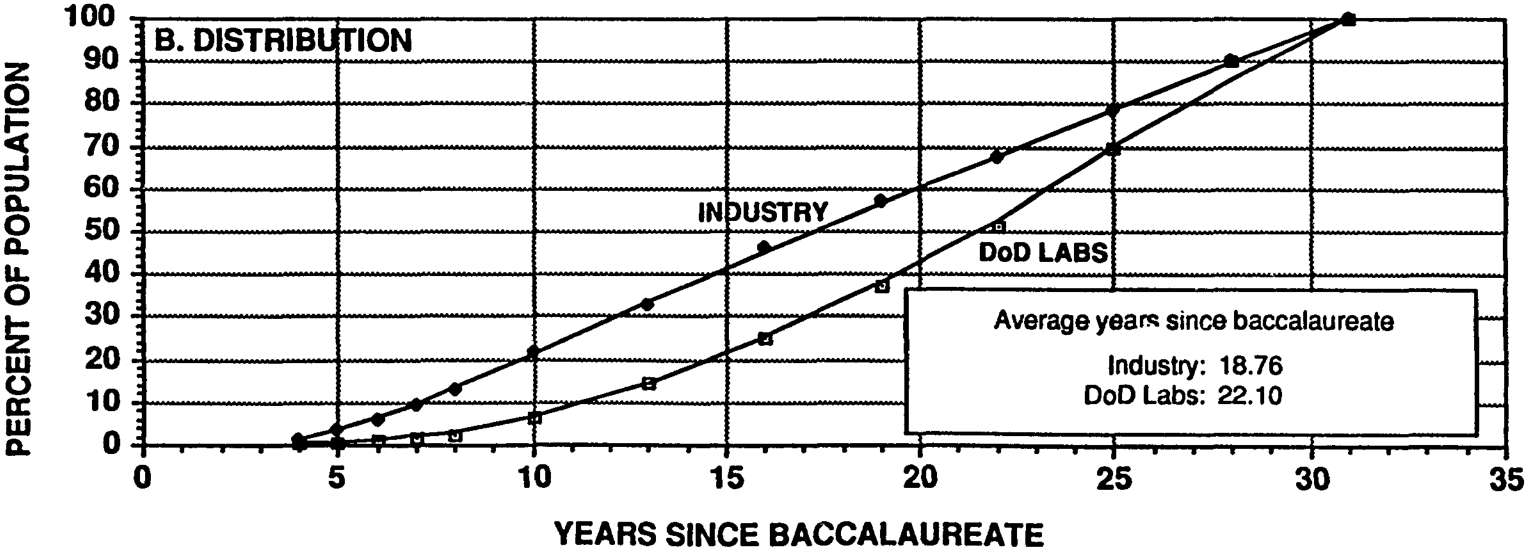


CHART S-6. 1987 SALARIES OF SUPERVISORY ENGINEERS, AT THE MASTER'S DEGREE LEVEL, DISTRIBUTED BY YEARS SINCE BACCALAUREATE

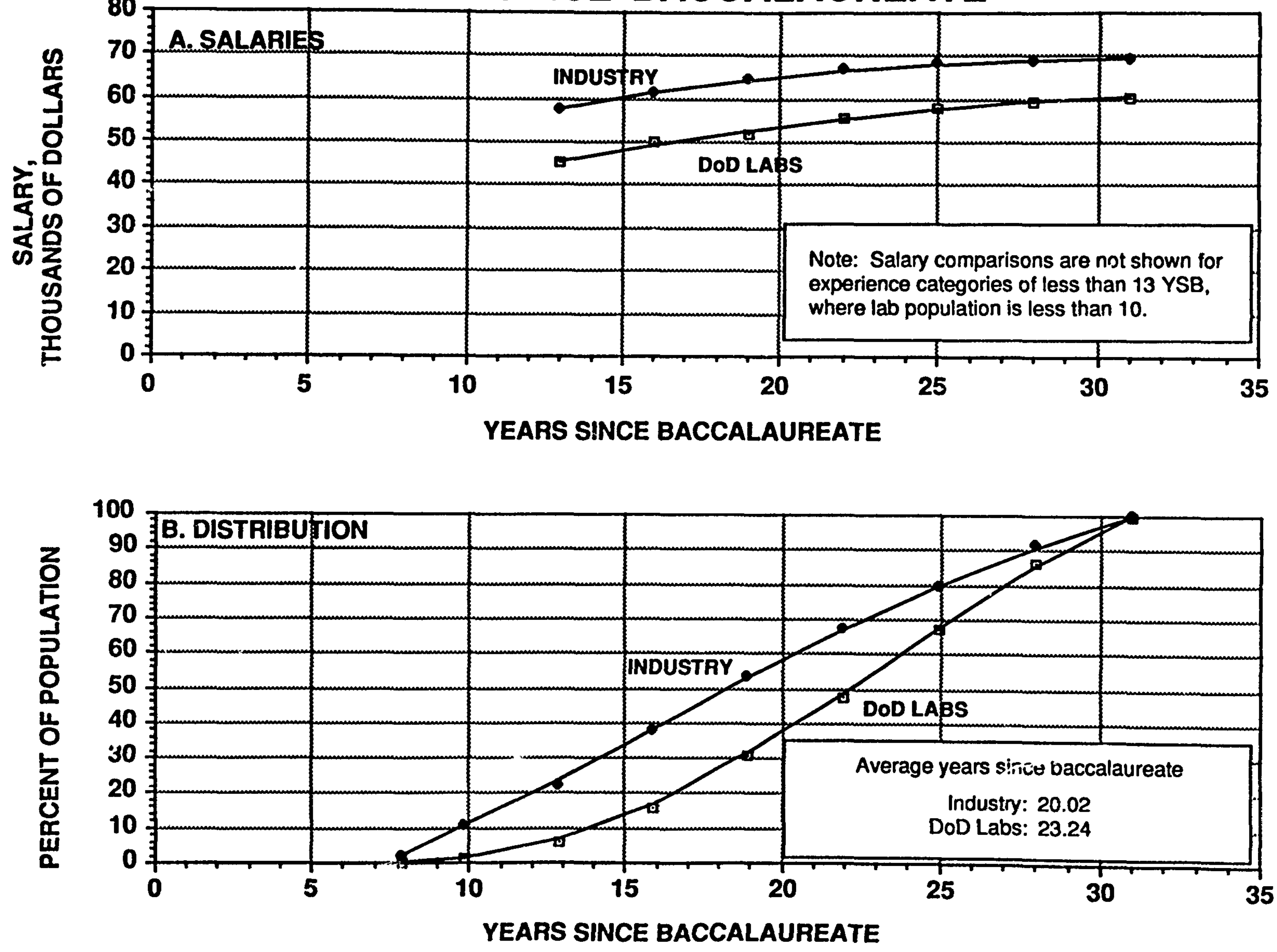
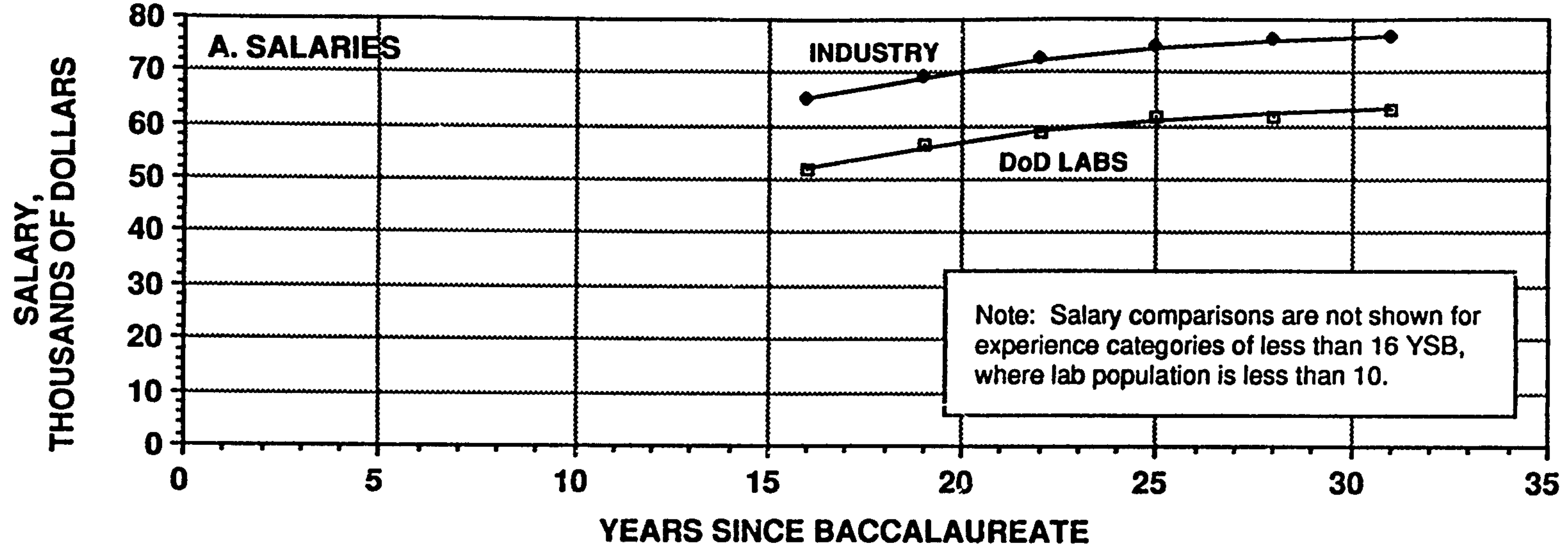


CHART S-7. 1987 SALARIES OF SUPERVISORY ENGINEERS, AT THE DOCTOR'S DEGREE LEVEL, DISTRIBUTED BY YEARS SINCE BACCALAUREATE



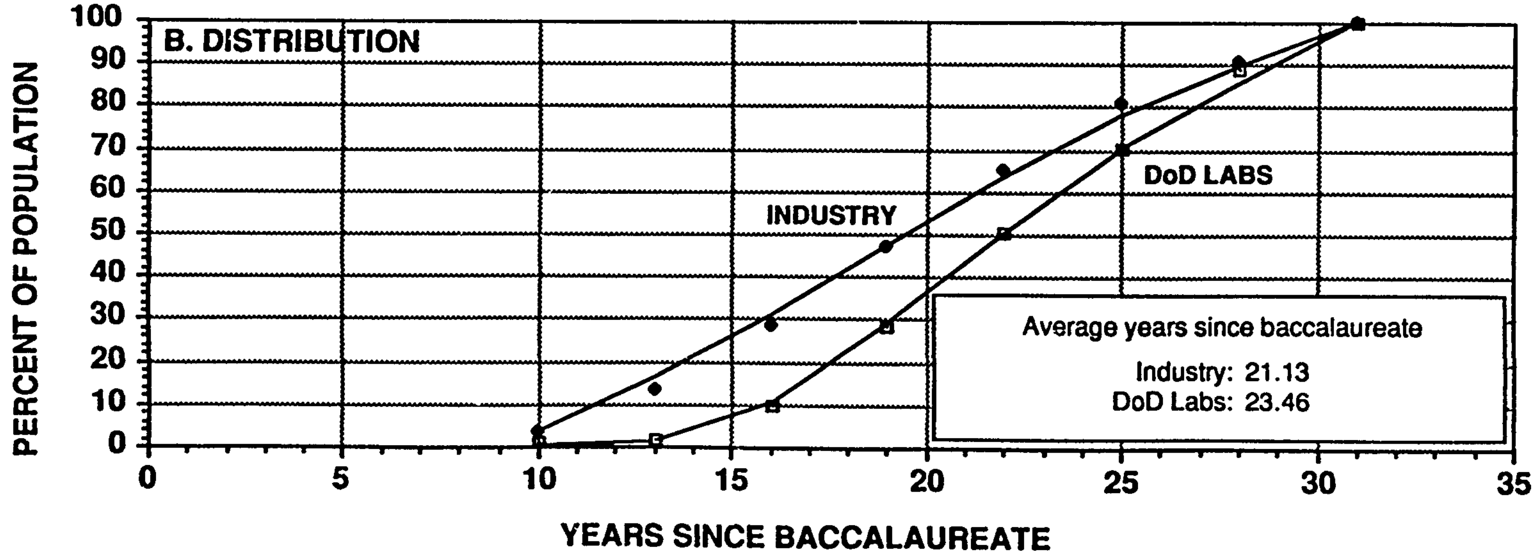
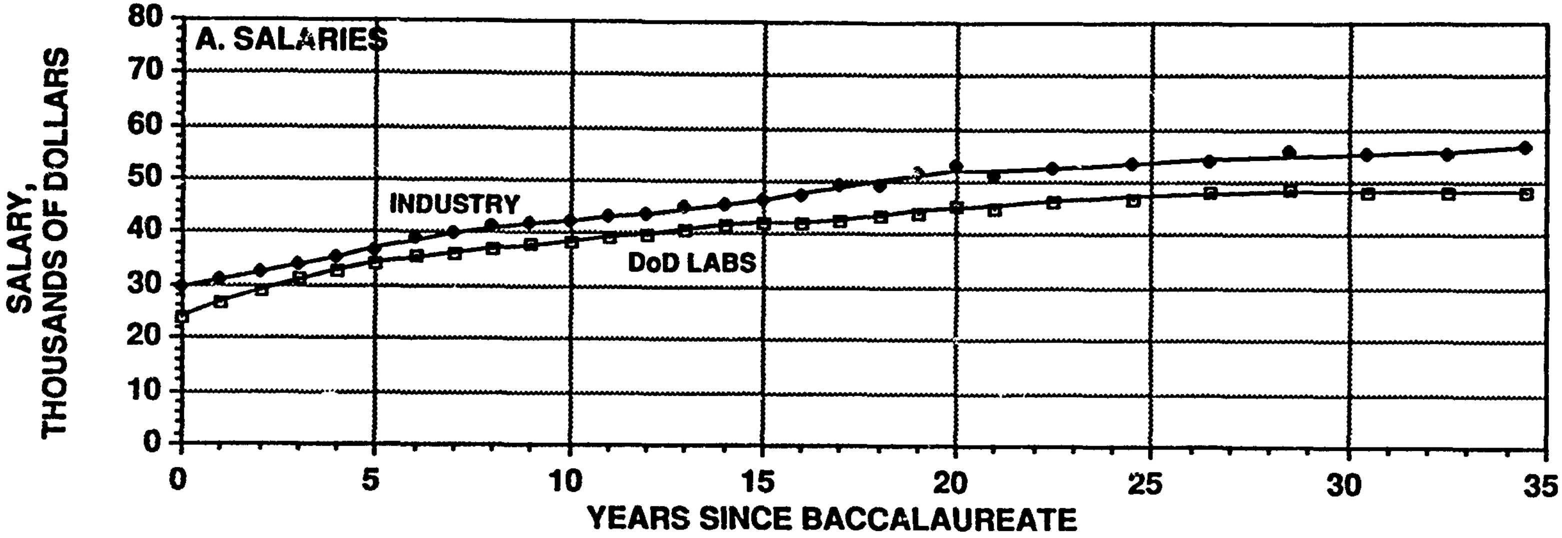


CHART S-8. 1987 SALARIES OF NONSUPERVISORY S&E, AT THE BACHELOR'S DEGREE LEVEL, DISTRIBUTED BY YEARS SINCE BACCALAUREATE



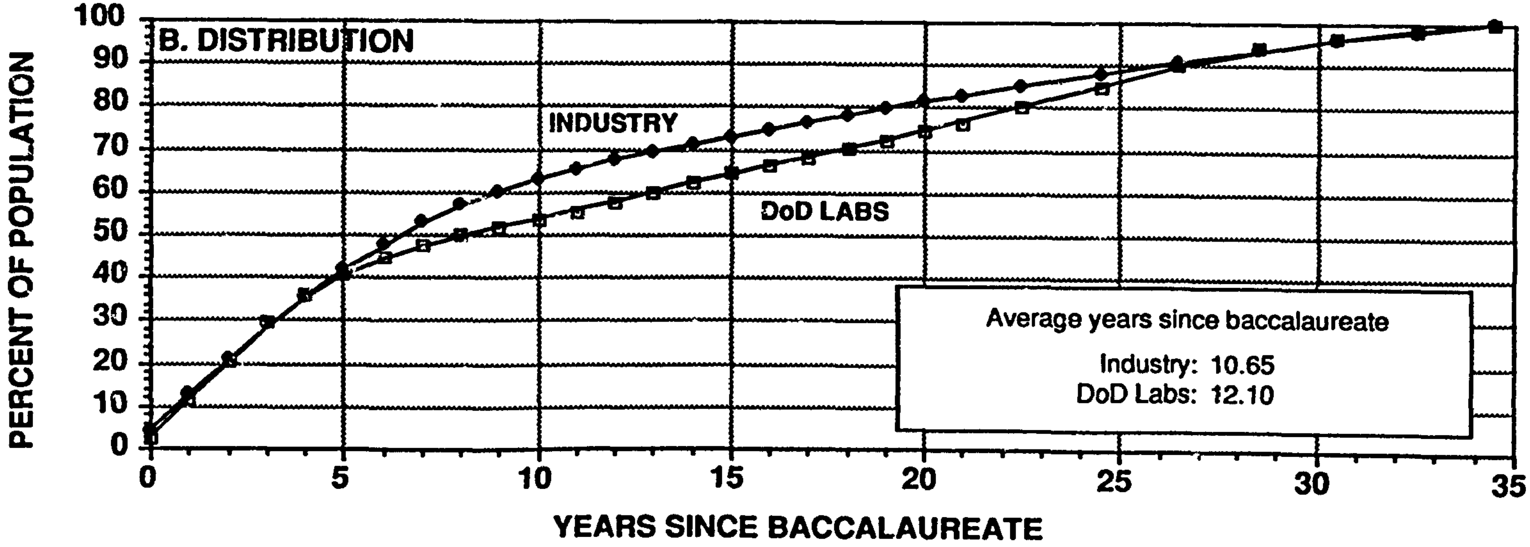


CHART S-9. 1987 SALARIES OF NONSUPERVISORY S&E, AT THE MASTER'S DEGREE LEVEL, DISTRIBUTED BY YEARS SINCE BACCALAUREATE

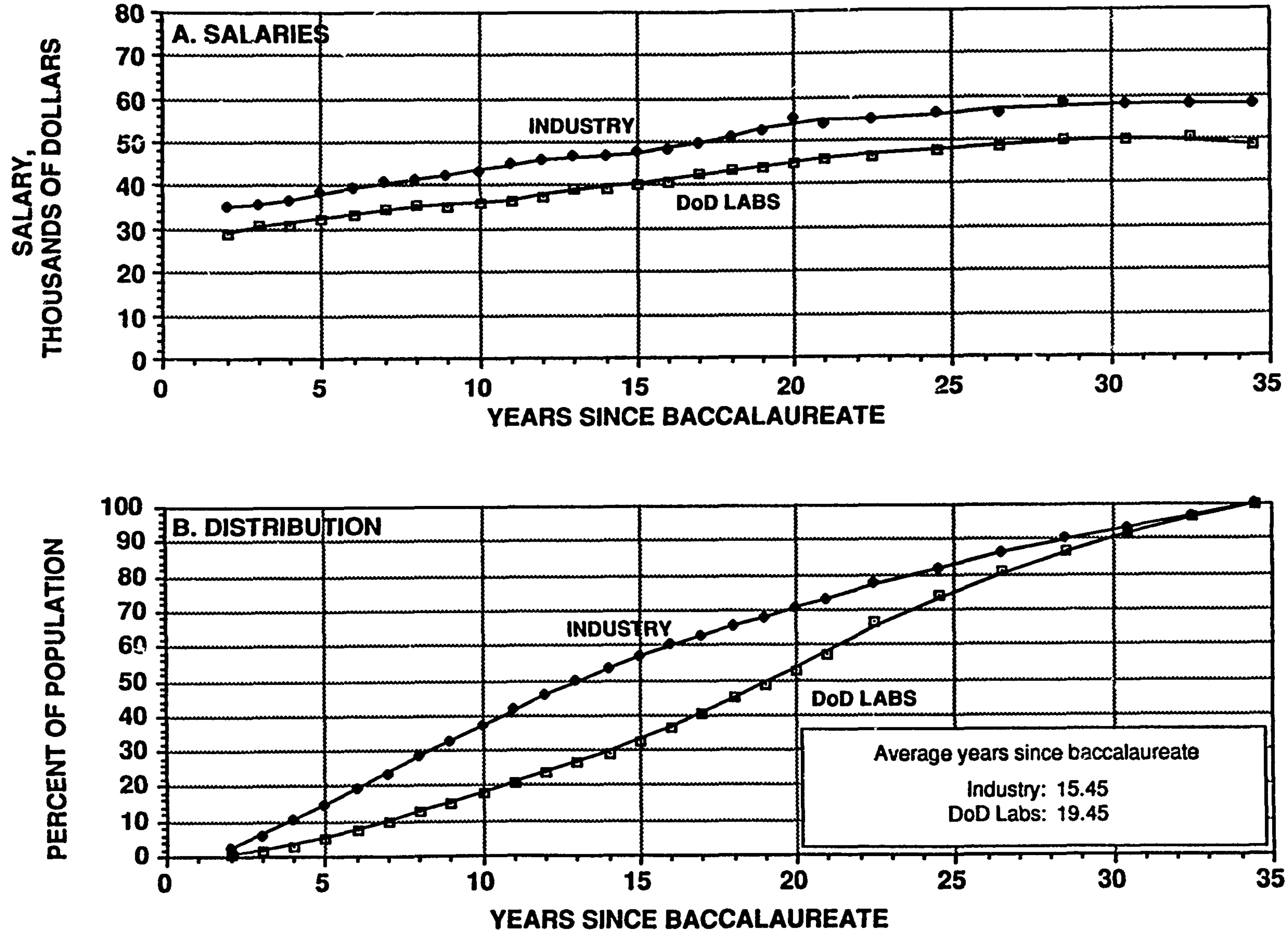


CHART S-10. 1987 SALARIES OF NONSUPERVISORY S&E, AT THE DOCTOR'S DEGREE LEVEL, DISTRIBUTED BY YEARS SINCE BACCALAUREATE

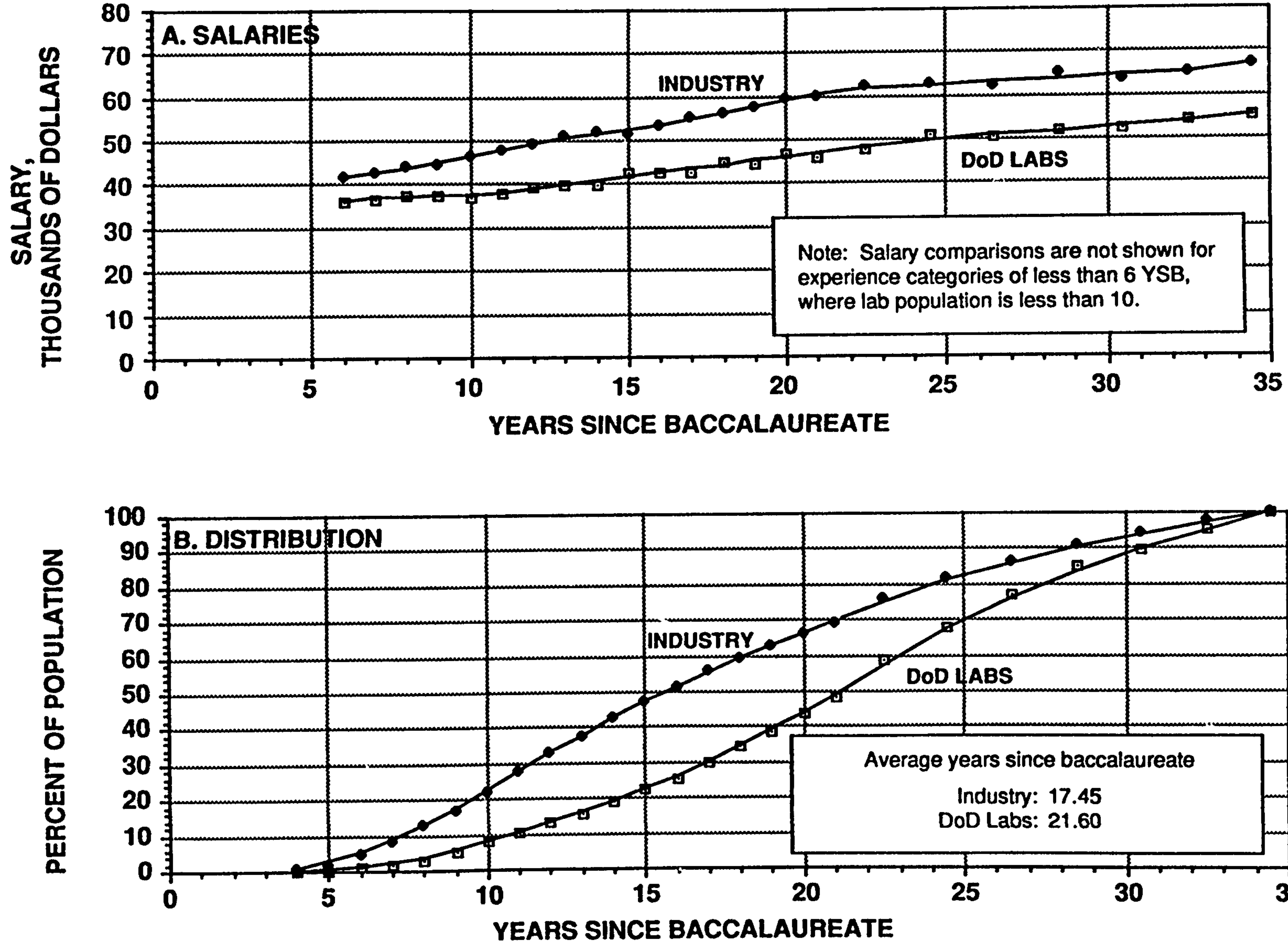


Chart S-8 shows pay differences of $3K to $7K over the careers of bachelor's-degree level S&E, who represent 62 percent of nonsupervisory S&E in the labs and 54 percent of nonsupervisory S&E in industrial R&D establishments.

Chart S-9 indicates the pay differences range from $6K to $9K for master's-degree level S&E, who are 25 percent of non-supervisory S&E in both the labs and in R&D establishments in industry.

In Chart S-10, we see the pay gap ranges from $6K to $13K for doctor's-degree S&E, who account for 13 percent of nonsupervisory S&E in the labs and 20 percent of nonsupervisory S&E in the R&D industry.

Chart S-11 shows that the gap in 1987 salaries increases with education level when we consider nonsupervisory S&E in the labs and industrial nonsupervisory S&E who work in R&D establishments; and we see larger salary differences as we look at higher percentiles.

In the DOE data base, salaries of *supervisory* S&E are not related to education level or years since baccalaureate. Instead, DOE calculates average, median, and other percentile salaries for two groups, viz., First Level Supervisors and Division Directors. Comparable 1987 salaries of lab S&E supervisors are shown in Charts S-12 and S-13, where salaries from the DOE data base pertain to the industrial sector alone and to all national sectors.

When we compare salaries in Charts S-12 and -13, we see that (1) differences in average salaries and percentile salaries grow more unfavorable to the labs as we go from First Level supervisors to Division Directors, and (2) salary differences increase with percentiles for both levels of supervisors.

2. The Issues

Our analytical objective is to determine whether a relationship, inferential if not causal, exists between the emergence of the pay gap and recruitment and retention. The important issues are: *Does the pay gap affect recruitment? Does the pay gap drive S&E from the labs?*

CHART S-11. COMPARISON OF PERCENTILE SALARIES IN CY 1987 OF NONSUPERVISORY S&E IN DoD LABS (D) [a] AND NATIONAL R&D LABS (N)[b] FOR THREE EDUCATIONAL LEVELS

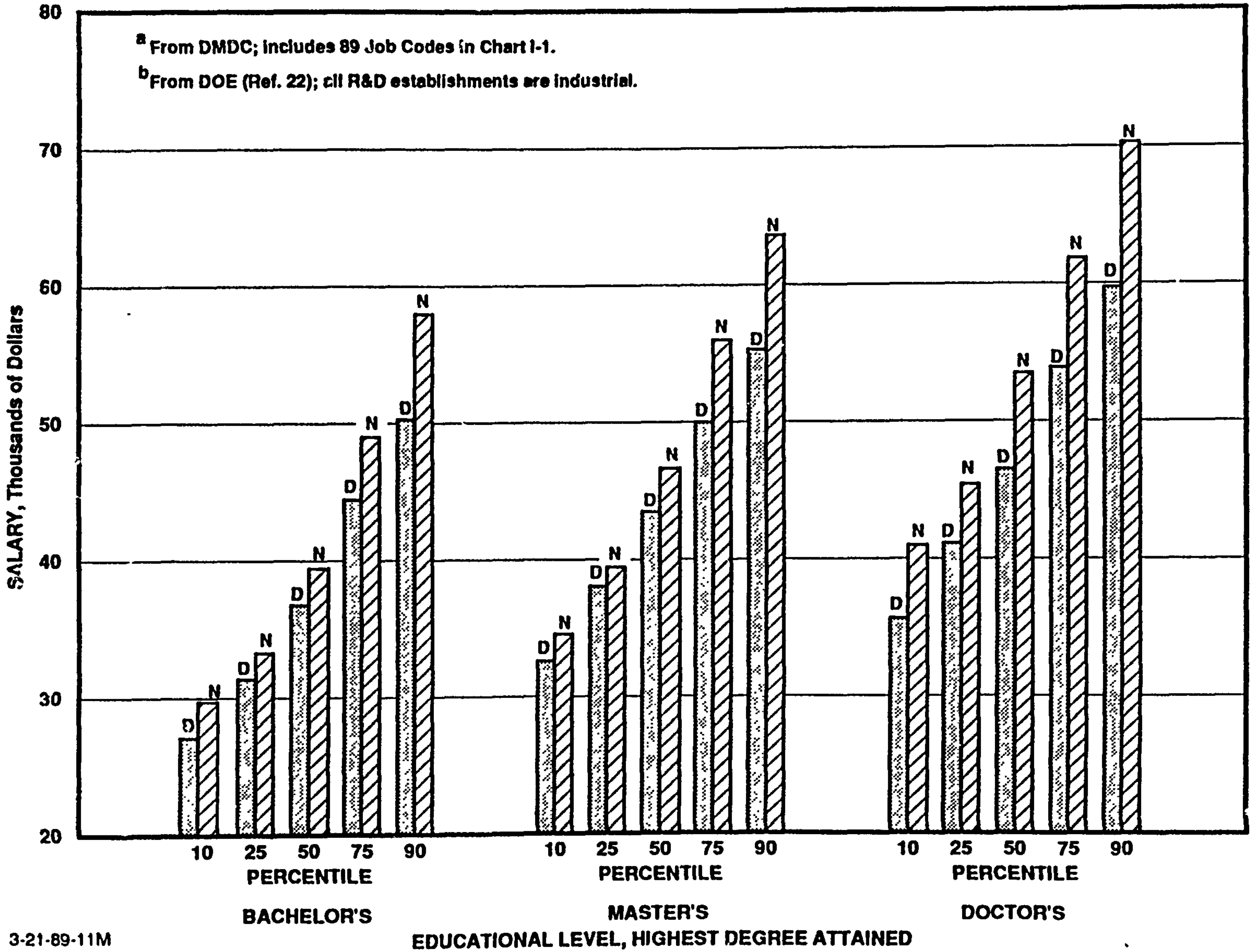


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CHART S-12. SALARIES OF FIRST LEVEL SUPERVISORS IN CY 1987

SECTOR	NUMBER OF SUPER-VISORS	AVERAGE SALARY, DOLLARS	PERCENTILE (P) SALARY, DOLLARS				
			10P	25P	50P	75P	90P
DoD LABS[a]	1,117	52,446	45,610	49,254	53,103	56,162	59,492
INDUSTRY[b]	2,317	58,392	45,192	50,832	58,548	64,992	70,080
NATIONAL[c]	4,403	59,004	45,888	51,504	59,364	66,000	71,004

[a] FROM DMDC; INCLUDES S&E (1) WHO HAVE ONE OF THE 89 JOB CODES LISTED IN CHART I-1 AND (2) WHO ARE GS-12, -13, OR -14 AND CODED "SUPERVISOR" OR WHO ARE CLASSIFIED AS GM-13 OR -14.

[b] FROM DoE (REF. 22); INCLUDES S&E SUPERVISORS IN INDUSTRIAL R&D ESTABLISHMENTS.

[c] FROM DoE (REF. 22); INCLUDES S&E SUPERVISORS IN R&D ESTABLISHMENTS IN SEVERAL SECTORS: INDUSTRY, FEDERAL GOVERNMENT, CONTRACT RESEARCH CENTERS, NONPROFIT ORGANIZATIONS, AND EDUCATIONAL INSTITUTIONS.

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CHART S-13. SALARIES OF DIVISION DIRECTORS IN CY 1987

SECTOR	NUMBER OF SUPER-VISORS	AVERAGE SALARY, DOLLARS	PERCENTILE (P) SALARY, DOLLARS				
			10P	25P	50P	75P	90P
DoD LABS[a]	982	60,140	46,565	54,344	62,655	67,368	69,978
INDUSTRY[b]	1,180	73,944	59,004	66,492	72,996	79,944	88,752
NATIONAL[c]	1,537	74,700	59,472	66,600	73,500	81,420	91,992

[a] FROM DMDC; INCLUDES S&E (1) WHO HAVE ONE OF THE 89 JOB CODES LISTED IN CHART I-1 AND (2) WHO ARE GS-15, -16, -17, -18 OR SES.

[b] FROM DoE (REF. 22); INCLUDES S&E SUPERVISORS IN INDUSTRIAL R&D ESTABLISHMENTS.

[c] FROM DoE (REF. 22); INCLUDES S&E SUPERVISORS IN R&D ESTABLISHMENTS IN SEVERAL SECTORS: INDUSTRY, FEDERAL GOVERNMENT, CONTRACT RESEARCH CENTERS, NON-PROFIT ORGANIZATIONS, AND EDUCATIONAL INSTITUTIONS.

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B. RECRUITMENT

Our examination of lab survey data and Defense Manpower Data Center (DMDC) file data on lab S&E indicates that the labs had a mix of troubles and successes in recruiting S&E.

1. Troubles

We found four indications of recruiting troubles:

a. Skill Shortages. Shortages of S&E with multidisciplinary skills are a continuing lab problem. In response to a survey question that asked the labs to identify skill shortages and to rate them *very serious*, *serious*, *somewhat serious*, or *not serious*, the following shortages of skilled personnel were serious or very serious in at least 20 percent of the labs: Artificial Intelligence (50 percent), Systems Engineering (48 percent), Computer Engineering (45 percent), Computer Networking (34 percent), Signal Processing (33 percent), Control System Engineering (29 percent), Robotics (26 percent), Human Factors (26 percent), Weapons Design (26 percent), Digital Communications (24 percent), Ceramics (24 percent), Fiber Optics (22 percent), Biomechanics (21 percent), and Acoustics (21 percent). Labs respond to these shortages by using contractors, who can pay premium salaries to attract S&E with scarce skills, to perform lab work. However, shortages can only be alleviated by this response because the labs still need some of the same S&E to oversee the work that is contracted out.

b. Advanced Degree Graduates. The manpower pool of physical scientists and engineers receiving advanced degrees available to the labs is shrinking percentagewise because so many students matriculating in S&E curricula at American universities are not U.S. citizens. At the doctor's degree level, more than one-fourth of the degrees in the physical sciences are awarded to foreign citizens, who are either aliens in the U.S. on permanent visas or non-immigrants on temporary visas. More than one-half of the Ph.D.'s in engineering are awarded to such aliens (Chart IV-3). At the master's degree level, one-fifth of graduating physical scientists and one-third of the graduating engineers are not American citizens (Chart IV-4). Many may become employable by the labs later when they gain citizenship, but some among them will surely be too settled in other jobs to think about joining the DoD.

c. Co-op Programs. Co-op programs, which the labs rate as the most effective means for recruiting entry-level S&E (Chart IV-7) provided substantially fewer S&E in 1986 (607) than five years earlier (829). Based on lab experience over the 1981-1986 period, our survey identifies co-op programs as the most successful means of converting S&E from part-time or temporary to full-time, permanent employment and keeping them for at least three years (Charts IV-9, -10, and -11). The utilization of this formerly fertile source of entry-level S&E has diminished significantly.

d. Long Hiring Process. The hiring process--from decision to fill a position until final approval of a job candidate to fill it--was (1) substantially faster in 1986 than in 1981 for Army labs, (2) about the same speed for Navy labs, and (3) substantially slower for Air Force labs filling GS-5 through GS-15 positions. The average elapsed time in 1986 for all labs was 3-1/3 months to hire GS-5s through -12s; 4-1/2 months to hire GS-13s, -14s, and -15s; and 8-1/2 months to hire a GS-16 or an SES (Charts IV-17, -18, -19, and -20). From informal inquiries about commercial practices and norms, we believe such time lines for making hiring decisions must adversely affect S&E recruiting; however, we have found no hard data that enables us to estimate the number of job candidates lost to sluggishness of the hiring process.

2. Successes

We found four indications of recruiting success:

a. Level of Education. For nearly a decade, the proportion of advanced degrees in the lab S&E workforce has remained almost constant: 13 percent Ph.D.s and 26 percent master's degrees (Chart II-24). Thus, we deduce that advanced-degree new hires and on-hand S&E who pursue advanced degrees are the educational equivalent of departing S&E.

b. Class Standing. Disproportionally high class standing of 1986 new-hire S&E with bachelor's degrees indicates the labs achieved about the same recruiting quality as they did five years earlier. In both 1986 and 1981, over 50 percent of the new bachelor's degree scientists were in the top quarter of their graduating classes and about 90 percent were in the top half. In those same two years, 40 percent of new-hire engineers with bachelor's degrees were in the top quarter and 80 percent were in the top half (Charts IV-15 and -16). We do not know that labs did or did not change their recruiting emphasis to schools different from those that were primary recruiting targets in 1981.

c. Job Offer Acceptance. A 1986 job offer acceptance rate of about 75 percent, which compares favorably to limited job-offer statistics found elsewhere, for entry-level S&E implies that the labs are attractive employers. The low rejection rate of job offers indicates that new S&E consider non-financial factors important reasons for taking lab positions (Chart IV-12). Later in this analysis, we will see that the lab attractions may not be entirely non-financial, however.

d. Ph.D. Physicists. The labs increased their population of this highly prized group of scientists by 25 percent from 1981 to 1986 (Chart VIII-9), a period in which the national population of Ph.D. physicists increased by 14 percent. This occurred despite a marked disparity in average salaries and percentile salaries (Charts VIII-46 and -47) for Ph.D. physicists, in the labs and in national R&D establishments, distributed by years since baccalaureate. Here again, we deduce that non-financial factors make the labs attractive employers.

C. RETENTION

Advantages in many non-financial factors, similar to those aiding recruitment, help the labs to retain S&E (Chart V-13) despite the pay gap. The disparity in pay for lab S&E vis-à-vis national S&E is only partially compensated by the small financial superiority of Federal benefits to personnel who retire under the old retirement system, the Civil Service Retirement System (CSRS) (Charts IX-1, -2, and -3). The latest (1988-89) retirement benefits comparison (Chart IX-3) indicates that for retirees with 20 years service and whose final salary or highest three-year salary is $45K or $55K, annual CSRS annuities are about 4 to 8 percent less than combined pension and social security benefits in the private sector; when that comparison is made for 30 years service, the annual CSRS annuities are about 3 to 6 percent better than combined pension and social security benefits in the private sector. This comparison favors CSRS annuitants more substantially when retirement is taken with 40 years service; however, lab population statistics (Chart II-35 and Charts VIII-33, -34, and -35) indicate that relatively few lab S&E delay retirement until they have more than 30 years service.

Two aspects of retirement plans appear more likely than small percentage differences in annuity tables to influence decisions about continuing employment with the government: cost of living adjustments (COLAs) and early retirement. The following reasons may explain the value of COLAs: (1) professional people, including S&E, are rational about career and employment choices, (2) such decisionmaking reflects recognition that ever-growing life expectancy means many years of retirement, (3) monetary inflation has become a fact of life, and (4) retirement pension plans that contain provisions for COLAs, like those in the Federal sector, are more highly valued than those that do not, like almost all private-sector retirement plans.

With regard to early retirement, most private-sector employees participating in defined-benefit pension plans could retire before normal retirement age and receive an immediate, but reduced, pension Few private-sector plans enable employees to retire, as the CSRS plan does, with full annuities at age 55 after 30 years of service, at age 60 with at least 20 years of service, or at age 62 with at least five years of service.

1. Resignations

Our study of retention concentrates on relating departure of S&E from the labs, by resignation or retirement, to lab salaries. The labs say that inadequate salary is the primary reason given for S&E resignations (Chart V-14). Statistics for the 1981-1988 period in Chart S-14 indicate that resignations are primarily a problem at the GS-5 through -11 grade levels (Chart V-7). While combined resignations for all grade levels peaked in 1985, the trend line (least square line) in Chart S-15 shows an average yearly growth rate of about 0.1 percent.

2. Retirements

Resignations are a phenomenon that concerns lower grade-levels (few upper-grade level S&E resign); retirements are a phenomenon associated with GS-12 and above (Charts V-7 and -8). Whereas resignations appear mildly affected by the disparity in pay, retirement statistics provide stronger inferential evidence that opportunities to work outside the labs are increasingly motivating lab S&E to retire. As the pay gap grew during the 1980s, lab S&E retirements increased from 1.3 percent of the S&E staff in 1981 and 1.1 percent in 1982 to 2.2 percent in 1988 (see Chart S-16). The trend line (least square line) of total retirements for all grade levels shows an average growth rate of about 0.2 percent per year (Chart S-15). Between 1981 and 1988, the percentage of retirement-eligible S&E who opted for retirement increased by 50 percent--from 18 percent to 27 percent (Chart II-35).

CHART S-14. RESIGNATIONS AS PERCENTAGE OF BEGINNING-OF-THE-YEAR STRENGTH

GRADE LEVEL	YEAR							
	1981	1982	1983	1984	1985	1986	1987	1988
GS - 5	5.1	4.3	$\boxed{10.7}$	9.1	6.3	7.7	2.1	8.7
- 7	7.0	6.6	7.6	$\boxed{9.8}$	9.3	6.2	5.3	5.7
- 9	4.8	4.9	5.0	$\boxed{8.4}$	$\boxed{8.4}$	7.2	6.1	6.6
- 11	2.7	2.1	3.4	4.8	$\boxed{5.5}$	4.6	4.7	4.9
- 12	1.9	2.0	2.2	3.1	$\boxed{3.5}$	2.7	2.5	2.4
- 13	1.3	1.0	1.2	1.4	$\boxed{2.1}$	1.2	1.4	1.2
- 14	1.3	1.1	1.1	1.2	$\boxed{1.6}$	1.3	1.0	0.7
- 15	$\boxed{2.4}$	2.0	0.9	1.0	1.3	1.1	0.8	0.9
- 16	0	0	0	1.4	$\boxed{3.1}$	2.0	0.5	2.7
ALL	2.1	1.9	2.1	3.0	$\boxed{3.5}$	2.8	2.4	2.4

$\boxed{}$ ~ PEAK VALUE

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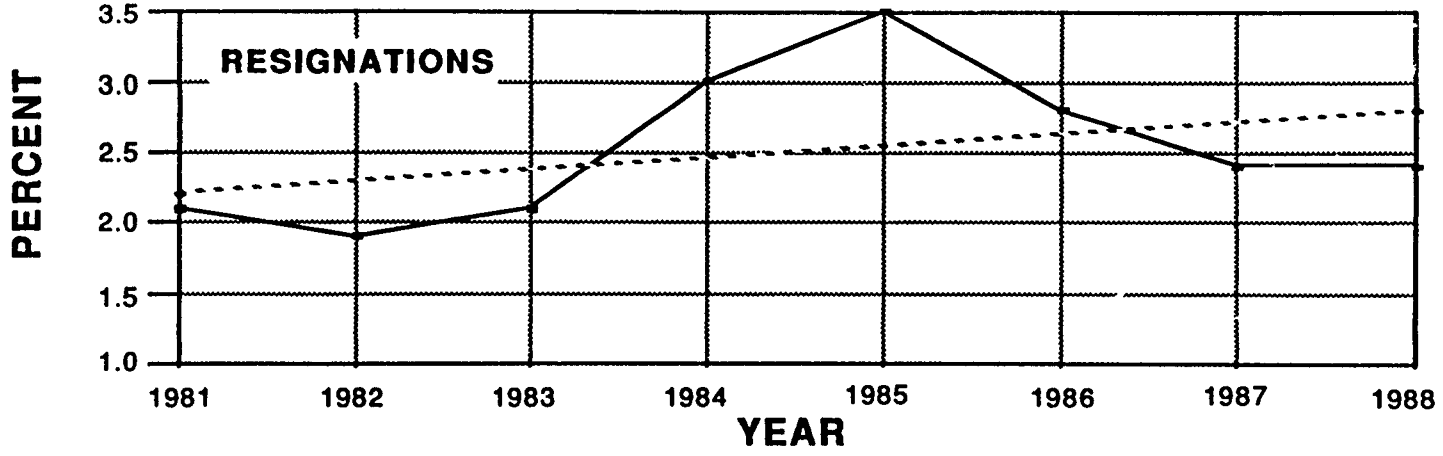
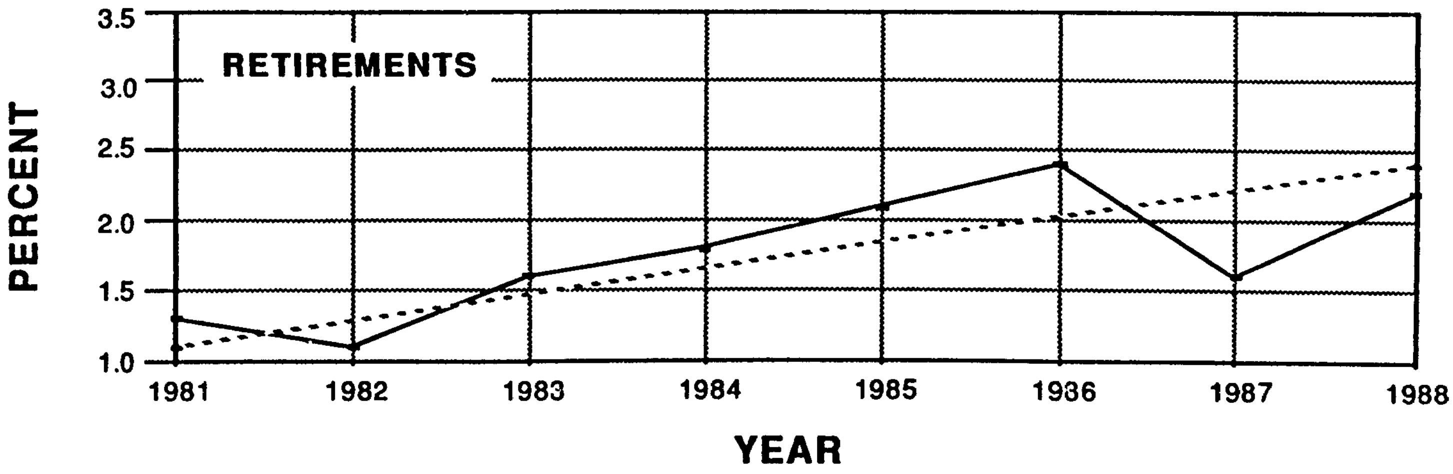
CHART S-15. PERCENTAGE LOSSES FROM RESIGNATION AND RETIREMENT OF LAB S&E FOR ALL GRADE LEVELS DURING THE 1980s





- - - - - - - - - Least Square Line

CHART S-16. RETIREMENTS AS PERCENTAGE OF BEGINNING-OF-THE-YEAR STRENGTH

GRADE LEVEL	YEAR							
	1981	1982	1983	1984	1985	1986	1987	1988
GS - 5	0	0	$\boxed{0.5}$	0	0	0	0	0
- 7	0	0	0	0	$\boxed{0.1}$	$\boxed{0.1}$	0	0
- 9	$\boxed{0.3}$	0.1	0.1	0.2	0.1	0.1	0	0.1
- 11	0.7	0.8	$\boxed{1.1}$	0.5	0.5	0.9	0.2	0.4
- 12	1.0	0.8	1.0	1.6	1.6	$\boxed{1.8}$	1.1	1.7
- 13	1.9	1.2	2.3	2.4	2.6	2.7	2.2	$\boxed{2.9}$
- 14	1.5	1.9	2.5	2.4	3.5	$\boxed{4.4}$	2.6	3.6
- 15	2.9	1.7	2.5	2.6	4.6	$\boxed{5.0}$	3.6	4.8
- 16	$\boxed{9.1}$	6.5	1.8	1.4	3.3	7.6	3.7	6.0
ALL	1.3	1.1	1.6	1.8	2.1	$\boxed{2.4}$	1.6	2.2

☐ ~ PEAK VALUE

Chart S-17 compares the defense programs for Procurement and RDT&E in the 1980s to the levels set for FY 1980. We see that resignations and retirements of lab S&E are correlated with changes in the defense budget; the coefficients of correlation between the annual defense budgets and resignations and retirements of lab S&E are 0.74 and 0.76, respectively. As spending rose in the early 1980s, expanding job opportunities in the defense industry attracted more S&E from the labs. As spending declined in the late 1980s and contractors reduced their hiring programs, fewer S&E resigned or retired.

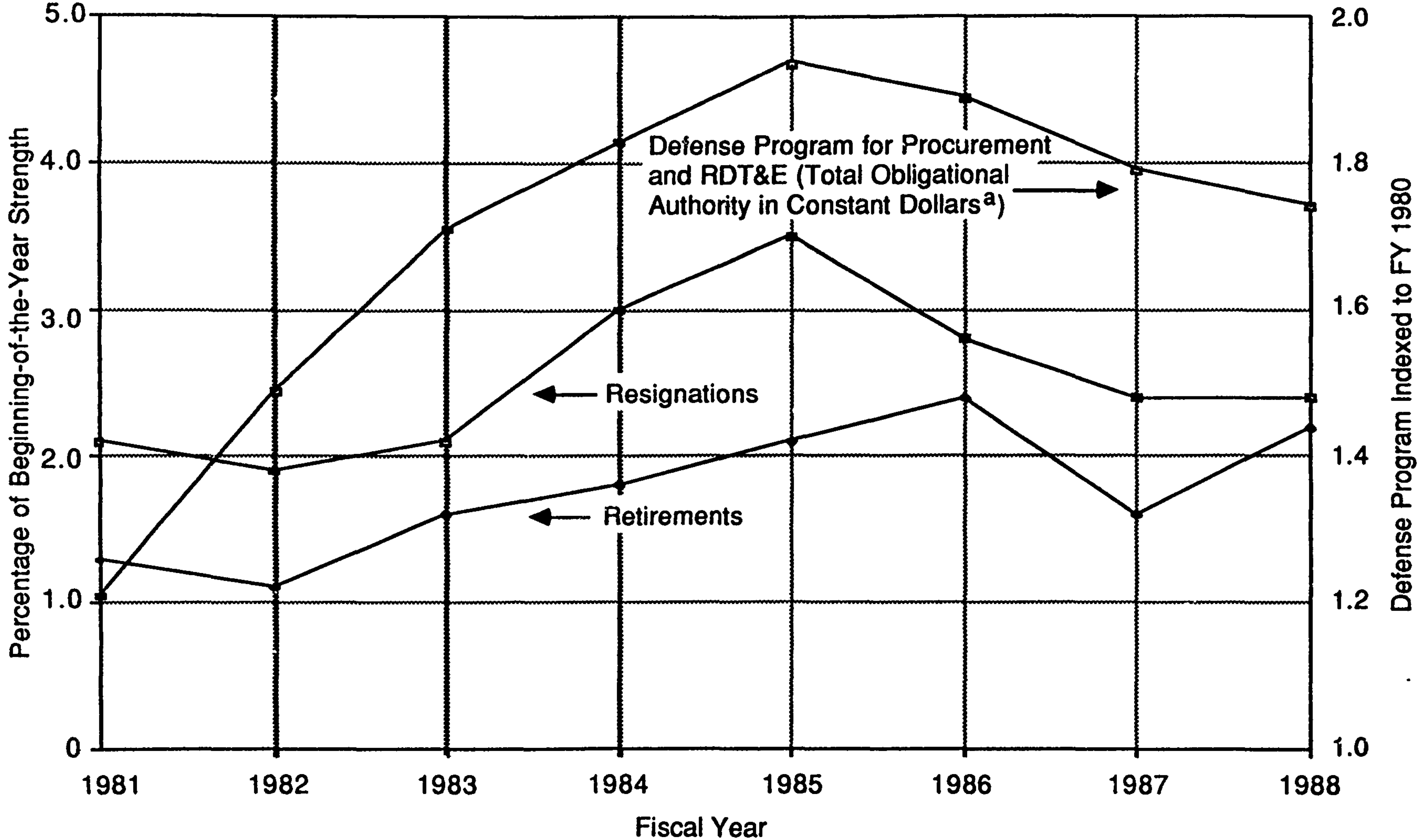
While the increase in lab S&E retirements in the 1980s appears to be related to an increasing attractiveness of salaries outside the labs, the new retirement system, Federal Employees' Retirement System (FERS) is likely, *under conditions of the 1980s*, to sustain or even accelerate retirements as lab S&E are increasingly covered by FERS, which took effect 1 January 1987, and less by the Civil Service Retirement System (CSRS) with each passing year. The FERS eliminates disincentives under the CSRS for Federal workers to pursue employment opportunities in the private sector (however, lessening the sense of becoming "captive" Fed‹ al workers could well improve S&E recruitment).

Recent geopolitical changes in Eastern Europe and the virtual collapse of the Warsaw Pact military threat indicate that conditions of the 1980s may not continue in the 1990s. The resultant shakeout in the U.S. Defense budget could bring about a positive effect on S&E retention to counter the negative effect of removing the retirement system that bound lab S&E to Federal employment. We expect that, in response to defense budget pressures, the labs would first try to reduce contracted-out work before they reduce in-house S&E. Moreover, as defense spending is reduced, we would expect fewer job opportunities in the private sector to attract lab retirees.

D. PAY AGAIN

Given the large pay gaps in Chart S-1, where we compared lab engineers' salaries grade level-by-grade level to salaries of engineers in industry, *how can we expect the labs to recruit and retain a competitive engineering workforce to fill jobs that account for less than one percent of all engineers' jobs in this country?* And *how do we reconcile the modest lab S&E resignation and retirement rates in Chart S-15 with the substantial opportunity costs (of foregoing employment by industry) that are implied by the career-long pay gaps when we compare lab and industry salaries year by year since baccalaureate in Charts S-3 through -10?* For answers, we look at the composition of the lab S&E workforce.

CHART S-17. COMPARISON OF RESIGNATION AND RETIREMENT TRENDS AND TREND IN DEFENSE PROGRAMS FOR PROCUREMENT AND RDT&E



[a] Source: DoD National Defense Budget Estimates for FY 1991 (Ref. 29)

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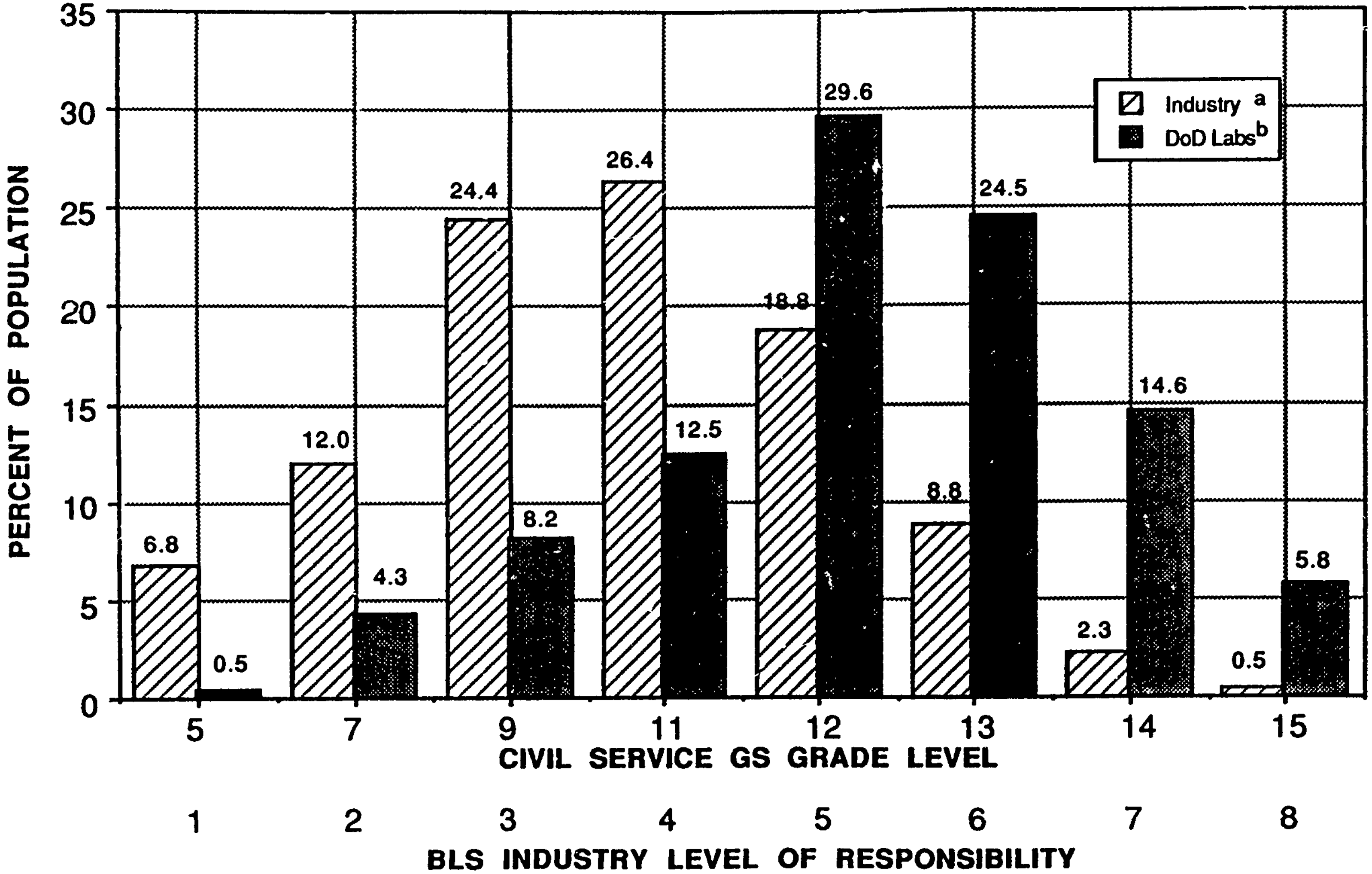
The distributions of engineers by level of responsibility in Chart S-18 show that 70 percent of national engineers are in the lower four levels and 30 percent in the higher four levels, whereas lab engineers are split 25 percent in the lower levels and 75 percent in the higher levels. Cumulative distribution curves in Chart S-19 indicate that the concentrations of national engineers at lower levels of responsibility and lab engineers at the higher grade levels are not just a 1986 phenomenon; the distributions were similar in 1981.

Chart S-20 indicates that the differences in average salary for comparable level of responsibility (national engineers) and civil service grade favor industry by about $7,300 to $17,700 per year, becoming greater at the more senior levels; the average difference is $12,000. For the two populations as a whole, weighted according to the number of engineers in each grade level, the average difference favoring industry is about $1,800 per year.

The more modest loss rates in Chart S-17 indicate that the use of special pay rates for occupations and locales where shortages of qualified job applicants have been documented has been relatively successful in bringing about, for DoD lab engineers, pay comparability with private-sector engineers. Special pay rates are in the form of (1) hiring entry-level engineers at above-normal step levels in the General Schedule and (2) accelerated early-career promotions for scientists and engineers. Our weighted average salary comparison gives us a measure of how successful the fast-track promotion approach has been, for engineers, in implementing the Federal Pay Comparability Act of 1970, which sought pay comparability between Federal white collar workers (professional, administrative, technical, and clerical--PATC) and their counterparts in industry. A more complex and costly approach to achieve pay comparability would involve Federal government adoption of industry's pay scales and career progression policies for Federal PATC employees. Under that approach, the weighted average salaries of federal groups and counterpart private-sector groups would be the same.

Scientists and engineers in the DoD labs tend to have more experience than those in industry when compared by years since baccalaureate (YSB) (Charts S-2 to S-10, part B). When compared according to equal years of experience, engineers in industry are favored over those in the DoD labs by differences that increase with level of experience (years since baccalaureate) and with education level by amounts up to over $1000 per month as illustrated by salary differences for three selected YSB in Chart S-21, where differences in salaries averaged over all YSB are, except for non-supervisory bachelor's degreed engineers, substantially lower than same-YSB differences. Similar results for non-supervisory S&E are found in Chart S-22: large salary differences for same levels of experience and smaller differences when salaries are averaged over all levels of experience.

CHART S-18. PERCENTAGE DISTRIBUTION OF ENGINEERS BY LEVEL OF RESPONSIBILITY IN 1986



[a] Source: Bureau of Labor Statistics (Ref. 1.1).
[b] Source: DMDC.

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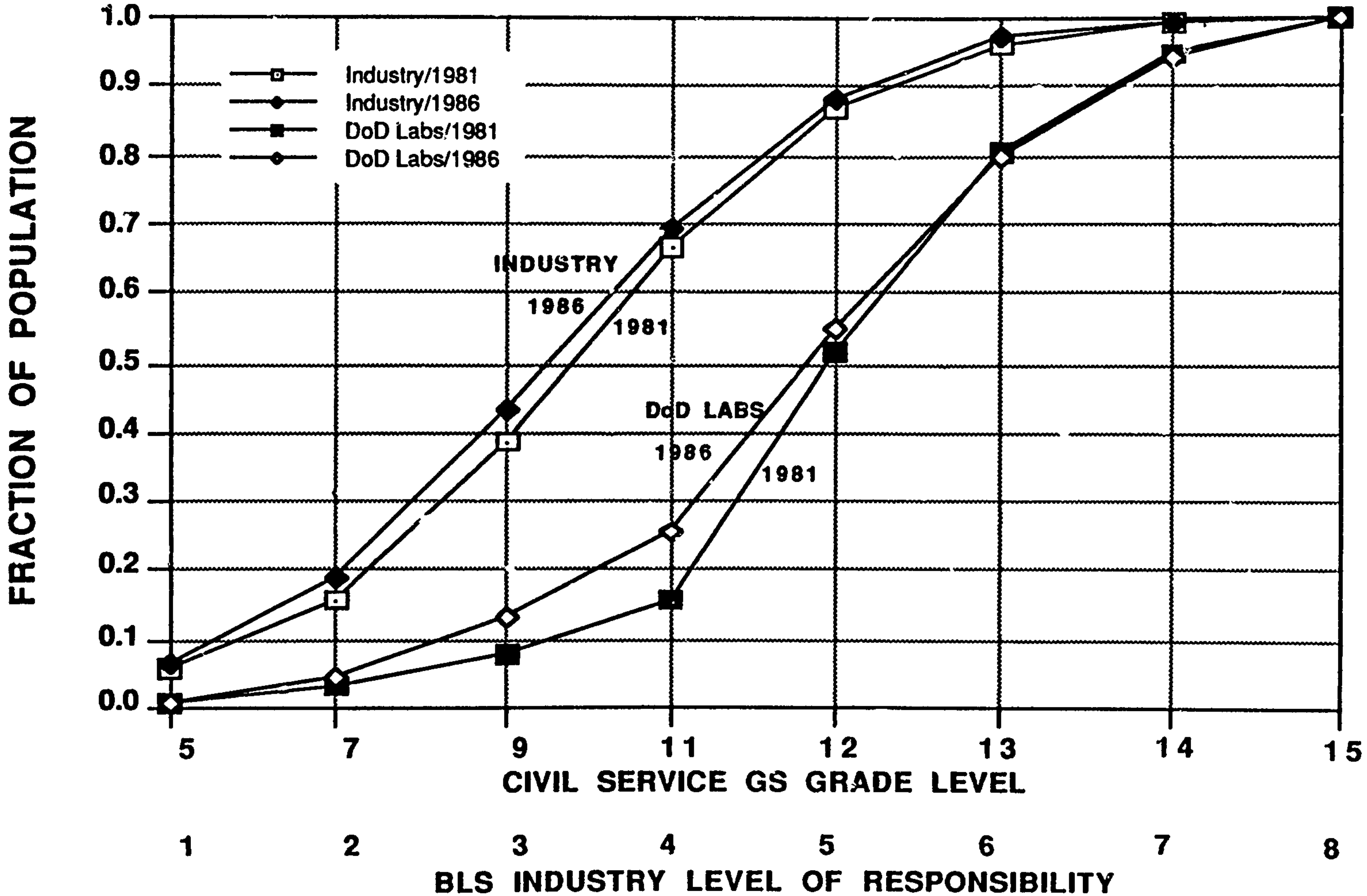
CHART S-19. CUMULATIVE DISTRIBUTION OF ENGINEERS IN U.S. INDUSTRY [a] AND IN DoD LABS [b] DISTRIBUTED BY LEVELS OF RESPONSIBILITY AND GRADE, RESPECTIVELY



[a] SOURCE: BUREAU OF LABOR STATISTICS (Refs. 12 and 14).

[b] SOURCE: DMDC; ALL SERIES-800 JOB CODES.

CHART S-20. CALCULATION OF ENGINEERS' AVERAGE SALARY IN 1986

NATIONAL[a]					DoD LABS[b]						
LEVEL OF RESPONSIBILITY	NUMBER	%	CUMULATIVE %	MEAN SALARY	GRADE LEVEL	NUMBER	%	CUMULATIVE %	AVERAGE STEP	SALARY[c]	SALARY[d] DIFFERENCE
1	40,469	6.8	6.8	27,866	5	71	0.5	0.5	10	18,710	9,156
2	71,336	12.0	18.8	31,194	7	602	4.3	4.8	10	23,170	8,024
3	145,165	24.4	43.2	35,715	9	1,150	8.2	13.0	10	28,347	7,368
4	157,033	26.4	69.6	42,677	11	1,738	12.5	25.5	9.5	33,853	8,824
5	111,913	18.8	88.4	50,769	12	4,133	29.6	55.1	5.6	36,467	14,302
6	52,105	8.8	97.2	58,883	13	3,414	24.5	79.6	6.5	44,491	14,392
7	13,395	2.3	99.5	68,602	14	2,038	14.6	94.2	6.4	52,427	16,175
8	3,097	0.5	100.0	79,021	15	807	5.8	100.0	6.2	61,320	17,701
TOTAL	594,513	100.0			TOTAL	13,953		100.0			11,993

[a] FROM BUREAU OF LABOR STATISTICS (REF. 14).
[b] FROM DMDC, EXCEPT SALARIES. NAVY DEMONSTRATION LAB PERSONNEL NOT INCLUDED.
[c] FROM 1986 ANNUAL SALARY RATES (REF. 16).
[d] NATIONAL MINUS DoD LABS.

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CHART S-21. 1987 SALARY DIFFERENCES FAVORING ENGINEERS IN INDUSTRY OVER ENGINEERS IN DoD LABS (THOUSANDS OF 1987 DOLLARS)[a]

EDUCATION LEVEL (HIGHEST DEGREE)	YEARS SINCE BACCALAUREATE (YSB)			AVERAGE DIFFERENCE OVER ALL YSB
	10[b]	20	30	
NONSUPERVISORY ENGINEERS				
BACHELOR'S	1.2	1.0	-1.1	1.6
MASTER'S	6.7	5.9	2.2	1.8
DOCTOR'S	9.7	9.1	7.8	6.1
SUPERVISORY ENGINEERS				
BACHELOR'S	1.5	5.6	2.7	1.2
MASTER'S	12.2[c]	12.0	9.1	7.3
DOCTOR'S	12.9[d]	12.9	13.2	10.3

[a] Source: Charts VIII-60, -61, and -62 and Charts VIII-65, -66, and -67.

[b] Or first YSB category in which lab population ≥10.

[c] 13 YSB.

[d] 16 YSB.

CHART S-22. 1987 SALARY DIFFERENCES FAVORING NONSUPERVISORY S&E IN INDUSTRIAL R&D ESTABLISHMENTS OVER NONSUPERVISORY S&E IN THE DoD LABS[a] (THOUSANDS OF 1987 DOLLARS)

EDUCATION LEVEL (HIGHEST DEGREE)	YEARS SINCE BACCALAUREATE (YSB)			AVERAGE DIFFERENCE OVER ALL YSB
	10	20	30	
BACHELOR'S	3.8	7.4	7.1	3.7
MASTER'S	7.1	10.6	7.7	4.4
DOCTORS	9.6	12.8	11.2	7.0

[a] Source: Charts VIII-33, -34, and -35.

E. CONCLUSIONS

- **A disparity in pay favoring national S&E over lab S&E has developed in the 1980s.** The pay gap is wider for S&E with advanced degrees, for S&E who are supervisors, and for S&E who are superior performers as indicated by percentile salaries.

- For similar levels of responsibility, the **1986 salaries of engineers in industry are variously $7K to $18K higher than those of engineers in the DoD labs;** the salary differences were greater at higher levels of responsibility (see Chart S-1). **The recruiting and retention handicaps that such level-by-level salary differences create are reduced by fast early-career promotions to levels where the pay is (more) comparable but experience is not:** the level-of-responsibility distributions for the two engineer poulations show that 70 percent of the national engineers were at the four lower levels whereas 75 percent of the lab engineers were at the four higher levels.

- For equal levels of experience (years since baccalaureate), the **1987 salaries of S&E in industry were generally substantially higher than those of counterpart S&E in the DoD labs;** the salary differences were greater at higher education levels (Charts S-2 through -10). **Scientists and engineers in the DoD labs have, on average, more experience than those in industry. The higher experience level in the labs tends to moderate salary differences that lab S&E would otherwise sustain when salaries are compared for equal levels of experience.** The experience advantage of the lab S&E work force may be due to (1) non-financial factors that make the labs attractive employers and (2) favorable aspects of the Civil Service Retirement System vis-à-vis private-sector pension plans: automatic cost of living adjustments and opportunity to retire earlier with full pension.

- **Despite evidence of serious recruitment troubles, several measures indicate that S&E recruiting in 1986 was about the same as it was five years earlier.** Indications of recruiting problems are: (1) shortages of S&E with multidisciplinary skills; (2) increasing proportions of physical scientists and engineers graduating with advanced degrees are not U.S. citizens and, therefore, are not employable by the labs; (3) diminished utilization of Co-op programs, which the labs rate as the most effective means for recruiting entry-level S&E; and (4) sluggish hiring processes. Indications of recruiting success are: (1) the proportion of the lab S&E workforce with advanced degrees has remained almost constant for nearly a decade; (2) the disproportionally high class standing of new-hire S&E with bachelor's degrees; (3) high acceptance rate of job offers; and (4) a 25-percent growth in the population of Ph.D. physicists.

- **Increases during the 1981-88 period in lab S&E resignation rate--up 0.1 percent per year--and retirement rate--up 0.2 percent per year--are inferentially linked to the development of the unfavorable pay gap. Both S&E loss rates are also closely related to the rise and fall of the Defense budget for procurement and RDT&E.**

- **It is too early to predict the net impact on lab S&E retention of two ongoing events--changeover in retirement systems, Civil Service Retirement System to Federal Employees' Retirement System, and reduced defense spending--that can produce opposite effects.** The gradual removal of a retirement system that binds lab S&E to Federal employment is expected to encourage resignations and retirements. An opposite effect on lab S&E retention is possible when (1) budget pressures from the shakeout in U.S. Defense--in response to the geopolitical revolution that is sweeping Eastern Europe--cause the labs to reduce contracted-out work before they reduce in-house S&E and (2) fewer job opportunities exist in the private sector to attract lab retirees.

III. FINDINGS

The findings are presented in the order in which the data are presented in the main report. Some of the findings are discussed in the preceding analysis of recruitment and retention.

A. S&E WORKFORCE

- The S&E workforce in the DoD labs grew 13 percent from 23,700 in 1981 to nearly 27,000 civilian and military personnel in 1986. During the same period, the DoD-wide S&E population grew by 21 percent. From 1981 to 1986, the civilian S&E workforces in the Army, Navy, and Air Force labs grew by five percent, 27 percent, and less-than-one percent, respectively. In that period, populations of military S&E in Army and Navy labs grew by 19 percent and 13 percent, respectively, while Air Force labs, which are much more dependent on the military for their S&E workforce, reduced their military S&E by 14 percent. (See Charts II-5, -8, and -21)

- Lab RDT&E budgets in FY 1986 were $2.4B, $2.2B, and $1.8B for the Army, Navy, and Air Force, respectively. They grew 45 percent, 19 percent, and 51 percent in constant dollars from 1981 to 1986 for the Army, Navy, and Air Force, respectively. During the same period, the percentage (dollar value) of RDT&E work contracted out by the labs increased from 58 percent to 62 percent in the Army and from 77 percent to 82 percent in the Air Force; the percentage stayed at 43 in the Navy. (Charts II-5 and -6)

- Between 1981 and 1986, the engineering component of the overall lab S&E workforce grew from 61 percent to 64 percent; engineers in the Army labs grew to 62 percent (up 3), Navy to 63 percent (up 2), and Air Force to 69 percent (up 4). (Chart II-8)

- A major change in allocation of S&E manpower by type of work in the labs from 1981 to 1986 involved a reduction in S&E allocated to Tech Base work from 45 to 37 percent. This change was driven by a decrease from 32 to 23 percent in the Navy labs. Substantial increases in S&E manpower allocated to System Development by Army labs (18 percent to 26 percent) and Navy labs (29 percent to 34 percent) contrasted to a steep decline in Air Force labs (15 percent to eight percent). (Chart II-10)

- On-base contractors employed S&E workforces in 1986 that were 15 percent, 19 percent, and 12 percent as large as the S&E workforce (civilian plus military) of the host labs of the Army, Navy, and Air Force, respectively. On-base contract work accounted for seven percent, four percent, and nine percent of the lab RDT&E budgets of the Army, Navy, and Air Force, respectively. (Charts II-6, -8, and -19)

- Physical scientists and mathematicians account for 70 percent of lab scientists in 1986; electrical and electronics engineers (EEs) and mechanical engineers account for 65 percent of lab engineers. These fields are a significantly larger part of the S&E workforce in the DoD labs than of the national S&E workforce. (Chart II-22)

- Over the period 1978-1986, the distribution of civilian S&E by education level has remained almost constant: about 13 percent with doctor's degrees, 26 percent with master's degrees, and 60 percent with bachelor's degrees. (Chart II-24)

- Over the same period, both average age (40.9 years in 1986) and average length of service (LOS) (15.2 years in 1986) of the civilian S&E population decreased about one year. The overall decrease results from decreases in age of S&E workforces of one year and 1.4 years in the Navy labs and Air Force labs, respectively, over a period in which the Army lab S&E workforce aged by 0.4 year. The overall reduction in LOS is driven by declines of about one year for Army and Navy S&E; the average LOS of S&E in Air Force labs is about the same now as it was at the end of the 1970s. (Charts II-26 and -27)

- There has been little change in the grade level distribution of civilian S&E in the labs over the 1978-1986 period: about 47 percent GS-13 through -15, 48 percent GS-9 through -12, and 5 percent GS-5 and -7. The average grade level of S&E in 1986 is 12.7 in the Air Force, 12.2 in the Army, and 12.0 in the Navy. (Charts II-28 and -29)

- Increases in the percent of women S&E employed in the labs (9.5 percent in 1986) have kept pace with corresponding increases in the national S&E workforce; the proportion of women in the national S&E workforce has been about five percent more than the proportion of women in the labs from 1978 to 1986. (Chart II-31)

- Minority S&E employment in the labs (9.5 percent in 1986) has kept pace with minority S&E employment nationally in the 1978-1986 period. (Chart II-31)

- From 1978 to 1988, the percentage of civilian S&E meeting age and length-of-service (LOS) requirements for normal retirement grew from seven percent to eight percent. During that same 10-year period, the percentage who met age and LOS criteria for "early-out" retirement (if base closing, reduction in force, or other action caused their jobs to be abolished) grew from 14 percent to 17 percent. (Charts II-34 and -35)

B. S&E HELP WANTED

- In terms of number of vacancies (authorized positions that are not filled), electrical and electronics engineering were the most troublesome fields with 270 vacancies in 1986. The biggest problem was electrical engineering, for which the vacancy rate was almost 20 percent. (Chart III-1)

- Nearly one-third of the labs (20 of 66) had vacancy rates of 10 percent or more of their authorized strength in 1986. (Chart III-4)

- The labs estimate they need about 13,000 additional S&E--50 percent more than currently authorized--to perform work of the labs. We do not know what fraction of the contracted-out work already discussed would be performed by this additional in-house S&E force. (Charts III-5 and -6)

- Shortages in multidisciplinary skills are a serious or very serious problem in at least 20 percent of the DoD labs: Artificial Intelligence (50 percent of the labs); Systems Engineering (48 percent); Computer Engineering (45 percent); Computer Networking (34 percent); Signal Processing (33 percent); Control System Engineering (29 percent); Robotics (26 percent); Human Factors (26 percent); Weapons Design (26 percent); Digital Communications (24 percent); Ceramics (24 percent); Fiber Optics (22 percent); Biomechanics (21 percent); and Acoustics (21 percent). (Charts III-7 and -8)

C. RECRUITMENT

- Promotions filled 53 percent of about 3,600 vacancies during 1986; 1,300 New Hires outnumbered 400 Reassignments and Transfers in filling other vacancies. (Chart IV-1)

- In 1986, 71 percent of S&E job openings for all grade levels were filled by Promotions and 30 percent by New Hires and Transfers. Five years before, these numbers were 61 percent and 38 percent. Filling GS-9, -11, and -12 openings with New Hires and Transfers has been reduced even more: 28 percent in 1986 versus 33 percent in 1981. The increased use of Promotions to fill these openings might imply an effort to improve retention of S&E on hand (Chart IV-2), as well as a decreased ability to attract New Hires and Transfers.

- Because so many students matriculating in S&E curricula at American universities are not citizens, the manpower pool of advance-degreed physical scientists and engineers available to the labs is shrinking. At the Ph.D. level in 1985, 27 percent of about 2,800 graduating physical scientists and 57 percent of 3,000 graduating engineers are not employable by the labs due to the citizenship requirement. Presumably, many will eventually become citizens and thus employable. At the master's degree level in 1983, the manpower pool of new graduates is also restricted: 20 percent of about 5,300 physical scientists and 36 percent of 19,000 engineers are not American citizens. (Charts IV-3 and -4)

- The most effective outreach activity for recruiting entry-level or journeyman S&E is personal contact between the prospect and S&E already working in the lab. (Charts IV-5 and -6)

- Co-op programs are the most effective means for recruiting entry-level S&E. They are a fertile source for developing full-time, permanent S&E from part-time or temporary lab employees. Despite their effectiveness as a recruiting source, the number of participants in Army and Navy lab co-op programs shrank from 306 to 207 and 428 to 304 personnel, respectively, from 1981 to 1986; the co-op program in the Air Force labs grew from 95 to 96. (Charts IV-7, -9, -10, and -11)

- The top attractions of the labs in recruiting S&E are: promise of interesting work, opportunity to use technical skills, availability of modern equipment, good location, good lab reputation, and availability of nearby universities. (Chart IV-12)

- The leading detriment to recruiting S&E is low pay. (Chart IV-13)

- For the labs overall, and the Army and Navy in particular, an acceptance rate of about 75 percent for job offers for lower-level (GS-5 through -12) positions is quite good compared to limited job-offer statistics found elsewhere. The data for acceptance rates, generally above 75 percent for higher grade level (GS-13 and above) positions, are suspect; the rates do not reflect, for many positions, the numerous desirable prospects who withdraw their candidacy or whose expected rejections discourage labs from making formal offers. (Chart IV-14)

- In 1986, as in 1981, the labs were able to recruit over 80 percent of their bachelor's-degree-level S&E from the top half of their graduating classes. Over 50 percent of the new scientists and 40 percent of the new engineers graduated in the top quarter of their classes. (Charts IV-15 and -16)

- Hiring GS-5s and -7s takes two to four months for the labs of all the Services: hiring GS-9s through -15s takes three to six months. Hiring to fill an SES position takes five months in the Navy, nine months in the Air Force, and 11 months in the Army. Since we do not have data relating the number of S&E prospects lost as a function of the length of the hiring process, we do not know how adversely recruiting is affected. The Air Force has the worst record in job-offer rejections, and the most sluggish hiring process. (Charts IV-18, -19, and -20)

D. RETENTION

- Over the 1978-1986 period, resignations accounted for about 46 percent of the yearly separations; retirements accounted for about 36 percent; transfers 13 percent; and death and discharge six percent. (Chart V-3)

- Resignations of lab S&E of all grade levels combined, as a percentage of beginning-of-the-year strength, rose from 2.1 percent in 1981 and 1.9 percent in 1982 to a high of 3.5 percent in 1985 and declined afterwards to 2.4 percent in 1987 and 1988. During the 1981-1988 period, resignation rates peaked in 1984-1985 for all grade levels except GS-5 (1983) and GS-15 (1981). (Charts V-7 and -9)

- Retirements of lab S&E of all grade levels combined, as a percentage of beginning-of-the-year strength, rose from 1.3 percent in 1981 and 1.1 percent in 1982 to a high of 2.4 percent in 1986, and then dropped to 1.6 and 2.2 percent in 1987 and 1988, respectively. Peak retirement rates during the 1981-1988 period occurred in 1986 for GS-12, -14, and -15 grade levels; in 1988 for GS-13s; and in 1981 for GS-16s. (Charts V-8 and -9)

- In 1981, 18 percent of 1,545 S&E eligible for normal retirement chose to retire. In 1988, 27 percent of 2,213 retirement-eligible S&E chose retirement. (Charts II-35 and V-8)

- The leading factors in aiding S&E retention are (1) interesting work, (2) opportunity to use S&E skills, (3) job security, (4) good lab reputation, and (5) opportunity to use modern equipment. (Chart V-13)

- Inadequate compensation and lack of advancement opportunities are the leading reasons for S&E resignations at all grade levels and from the labs of all Services. (Charts V-14 and -15)

- Rates of promotion of eligible middle-level S&E have increased substantially from 1981 to 1986: GS-9 promotions rose 15 percent (61.0 to 69.9 percent); GS-11 promotions rose 28 percent (31.0 to 39.8 percent); GS-12 promotions rose 47 percent (7.4 to 10.9 percent); and GS-13 promotions rose 52 percent (5.4 to 8.2 percent). Promotion rates for GS-14s rose 8 percent (5.0 to 5.4 percent) and 44 percent (1.6 to 2.3 percent) for GS-15s. (Chart V-16)

- Lab personnel officers say that the most serious effects of salary limitations, authorization ceilings, limited high-grade positions (GS-13 through -15), and bureaucratic constraints are (1) a hindrance to recruitment and retention, (2) failure to promote deserving S&E, and (3) impairment of S&E morale. (Charts V-21, -22, and -23)

- Lab directors say that low pay is the principal S&E problem. The next most serious problems are manpower constraints, centralized management, and too few high-grade positions. (Chart V-24)

E. TRAINING

- Almost all lab S&E participate in training programs that last at most one month. Less than 10 percent take part in programs that are longer than one month. (Chart VI-1)

- Virtually all S&E attend scientific and skills training; almost 40 percent attend some type of management training. (Chart VI-2)

- At two-thirds of the labs (42 of 66), educational institutions provide graduate and post-graduate technical education. (Chart VI-4)

- Most of the labs (37 of 42) provide some cost-sharing of this education; 25 labs pay 90 percent or more of the cost of education. (Chart VI-4)

- The major difficulty in providing training for lab S&E is work load demands on time (reported by about 40 percent of the labs). (Chart VI-6)

F. SENIOR EXECUTIVE SERVICE

- The number of senior executives--SES, PL 313, and GS-16 to -18--has grown nine percent (195 to 213) from 1981 to 1986. Senior executive vacancies are down substantially from 58 in 1981 to 18 in 1986. (Chart VII-1)

- As many lab directors consider the SES system to be good as do those who consider it fair or poor. (Chart VII-2)

- Few lab directors evaluate the SES rotation procedure as good. The two most-often cited defects are an unrecognized need [outside the lab] for technical knowledge in high-level positions and the financial burden of moving. The most-often cited consequences are that the rotation system is not implemented significantly nor used effectively and that positions are not filled by qualified people. (Chart VII-3)

- Less than 10 percent of the lab directors think that the salaries or bonuses of SES are good enough. One half of the directors believe that SES pay is too low and not competitive with industry. And one half thinks SES bonuses are too small. (Chart VII-4)

G. PAY

- When compared to national average annual salaries developed from National Science Foundation surveys of S&E without regard to such measures as age, education, length of service, or level of responsibility (equivalent to grade level), lab scientists were paid an average $5K more than scientists nationally in 1986, and lab engineers were paid an average $1K less than the national population of engineers. (Chart VIII-3)

- When 1986 salaries of engineers distributed by level of responsibility are compared, the average salaries of lab S&E are $7K to $18K less than those of national engineers at the same levels of responsibility. However, relatively few lab engineers (25 percent) are in the lower four of eight General Schedule (GS) grade levels (GS-5 to -15) while U.S. Bureau of Labor (BLS) survey data show that most national engineers (70 percent) are in the lower four levels of responsibility that correspond to the GS grade levels. These markedly different distributions of the two engineer groups by level of responsibility lead to the interesting fact that the overall weighted average salary of the two groups differs by $2K, compared to differences of $7K to $18K that favor national engineers by level of responsibility. As a result of faster early-career promotions, the median grade of lab engineers is GS-11.8; the median level of responsibility of national engineers corresponds to a GS-9.5. (Charts VIII-5 and -8)

- Pay-comparability analyses for 1986 involving income data developed by surveys of professional societies--viz., the American Institute of Physics, the Institute of Electrical and Electronics Engineers, and the National Society of Professional Engineers--show marked inferiority in lab pay for Ph.D. physicists and for engineers generally and in certain fields--viz., civil, EE, and mechanical. This inferiority exists for mean, median, and other high-percentile salaries and the inferiority exists regardless of the measure--age, education, length of service, or level of responsibility--to which pay is related. (Charts VIII-11 through -31)

- While the national population of Ph.D. physicists in 1986 showed a 14 percent increase from five years earlier, the lab population of these highly-prized scientists grew 25 percent (from 783 to 975). (Chart VIII-9)

- Professional-society members' income surveys provide questionable standards for evaluating lab S&E pay for two reasons. First, statements about income from society members, who are surveyed individually, are not checked for validity. By comparison, other surveyors--viz., the National Science Foundation (NSF), the Bureau of Labor Statistics (BLS), the Department of Energy (DOE), and the Engineering Manpower Commission (EMC)--direct their data inquiries to organizations that provide employee income data from payroll records. These data are comparable to pay data provided by the Defense Manpower Data Center (DMDC) for lab S&E. Second, we do not know whether the professional society populations are representative of corresponding lab S&E populations.

- The average salaries of nonsupervisory lab S&E at the bachelor's-, master's-, and doctor's-degree levels are $2.5K, $4.5K, and $7K, less, respectively, than the salaries of equally-educated counterparts in Industry. Differences in percentile salaries of nonsupervisory S&E in the labs and in Industry in 1987 were larger for higher levels of education and for high percentile S&E; for example, 90-percentile S&E in Industry earned $7K, $8K, and $11K more than did 90-percentile S&E at the bachelor's-, master's-, and doctor's-degree levels, respectively, in the labs. These comparisons are DOE-reported salaries of nonsupervisory S&E in Industry as a function of time (years) since receipt of bachelor's degree. (Charts VIII-36 and -37)

- With regard to salaries of supervisory S&E, the 1987 DOE-developed average salary of First Level Supervisors in Industry is about $6K more than the average salary of comparable lab supervisory S&E. At low (10 and 25) percentile salaries, the pay of these lab supervisory S&E is about equal to the pay of their Industry counterparts. However, at the 50-, 75-, and 90-percentile levels, salary differences grow from $5K to $11K in favor of Industry. (Chart VIII-58)

- The 1987 DOE-developed average salaries of the next level of supervisors, viz., Division Directors, in Industry are about $14K above those of corresponding supervisory S&E in the labs. Percentile salary differences favoring industrial Division Directors grow from about $13K at the 10th percentile to $19K at the 90th percentile. (Chart VIII-59)

- With regard to the pay of engineers only, EMC-developed average salaries of nonsupervisory engineers in Industry were better in 1987 by about $1.5K, $2K, and $6K than were those of lab counterparts with bachelor's, master's, and doctor's degrees, respectively. For the bachelor's- and master's-degree levels, differences in percentile salaries are less than $3K, in favor of Industry, across the range of 10-to-90 percentile salaries for nonsupervisory S&E; for nonsupervisory engineers with doctorates, the differences favor Industry by $5K to $8K. (Charts VIII-63 and -64)

- The 1987 EMC survey data indicate that average pay differences favor supervisory engineers in Industry by about $1K, $7K, and $10K over the salaries of corresponding supervisory lab engineers with bachelor's, master's, and doctor's degrees, respectively. Low-percentile-salary differences at the bachelor's-degree level favor supervisory engineers in the labs; higher-percentile salary differences at that education level favor industrial engineers. At the advanced-degree levels, salaries are better in Industry as we consider higher percentiles. For example, 90-percentile supervisory engineers with master's degrees are paid \$13K more than in the labs; if the 90-percentile supervisory engineers have Ph.D.'s, they are paid \$18K more in Industry. (Charts VIII-68 and -69)

H. BENEFITS

- Two early-1980s studies of total compensation comparability indicate that retirement pensions and other benefits, valued as a percentage of pre-retirement pay, are about 3 to 7 percent more favorable to Federal workers than to workers in the private sector. (Charts IX-1 and -2)

- A comparison of very recent retirement system data indicates that for professionals who retire with 30 years service and whose final or highest salary is \$45K to \$55K, the percentage of earnings replaced by pension is about 3 to 6 percent in favor of the Federal worker; if retirement occurs after 40 years, the pension advantage for the Federal worker increases to 16 to 20 percent. (Chart IX-3)

- In an age of varying but continuing inflation, the pensions of Federal retirees are automatically tied to increases in the cost of living, whereas less than five percent of the participants in private-sector pension plans are compensated for inflation, except for Social Security increases. (Charts IX-1 and -3)

I. INTRODUCTION

I. INTRODUCTION

A. BACKGROUND

In an era of rapidly advancing technology, the ability to attract and retain high-quality scientists and engineers (S&E) by the DoD laboratories ("labs" hereafter) is important to our national defense posture. Concern for S&E in the DoD labs motivated a study of that workforce by an ad hoc Laboratory Management Task Force (LMTF) in 1981-82.

The LMTF was asked to determine the status of DoD lab S&E (e.g., populations, vacancies, education level, comparisons with national S&E, etc.) to identify special lab problems in recruiting and retaining S&E, to evaluate recruiting and retention programs, and to identify future needs for S&E personnel. The LMTF report (Ref. 1) provides a statistical picture of lab S&E in 1981.

B. OBJECTIVE

The objective of this study is to provide a comparative portrayal of lab S&E in 1986. The scope of work includes updating recruitment and retention data from five years earlier, analyzing newly collected data, and identifying trends in S&E recruitment and retention in the 1980s.

C. APPROACH

The two principal sources of data collected for this study are (1) DoD lab answers to survey questionnaires and (2) personnel data from the Defense Manpower Data Center (DMDC).

1. Survey

We mailed questionnaires to the directors of the 66 Army, Navy, and Air Force labs. We assume that lab personnel offices provided most of the requested data.

The lab questionnaire is contained in Appendix A. While our survey questionnaire is similar to that used in 1981, there are essentially two changes. First, in order to increase quantification of lab responses, most of a dozen open-ended questions that were answered narratively five years ago were revised to multiple-choice form--the choices were largely items mentioned in the narrative responses in 1981. As a result, we have been able to develop more statistics concerning recruitment and retention. Our current questionnaire still contains four such open-ended questions--three of them give lab directors opportunities to speak their minds. A second change involved the dropping of lab technicians as a study subject so that S&E were the sole focus.

After patiently waiting for--and prodding--a few late-responding labs, we succeeded in receiving completed survey questionnaires from all 66 labs. All labs did not answer every question and a lab response to a question does not imply that data were provided for all elements of the question. An average of 92 percent of the labs answered each question, and we estimate that a similar percentage represents the typical response to all parts of any question.

2. Defense Manpower Data Center

As in the earlier lab S&E study, we use substantial DMDC data to investigate S&E workforce trends over the past several years. And because of our concern that late-responding (to our survey) labs would not complete their questionnnaires, DMDC was a backup source of data expected from the labs.

In several instances, we see differences between data from our lab survey and lab S&E data from DMDC, whose originating sources are the same labs, on the same subject. Maybe these differences would disappear if we had a 100 percent lab response to all elements of all survey questions. We have no way of knowing. However, the differences do not obscure general consistency wherever data from the two sources are compared, and they do not affect the study findings.

Comparability of pay of DoD labs S&E and national S&E became a major--if not *the* major--issue of this study. Numerous and extensive data runs on lab S&E pay were provided by DMDC. Most of the DMDC data runs on pay pertain to 1987, a year later than the 1986 timeframe of our lab survey. And in order to investigate the effects of pay on S&E departures, additional DMDC data runs were concerned with resignations, retirements, and retirement eligibility in 1987 and 1988.

3. "Scientists" and "Engineers" Defined

In this study, as in the one five years ago, "scientists" consists of persons whose occupations are represented by the 67 job codes and fields listed in Chart I-1. "Engineers" consists of those persons whose occupations are indicated by the 22 job codes and fields in that chart. Unless indicated otherwise in this report, S&E are full-time, permanent personnel.

D. REPORT PRESENTATION

Since it is unlikely that copies of the earlier study are readily available to interested readers, statistics from that study are incorporated throughout this report to facilitate then-and-now comparisons for 1981 and 1986. In order to quickly convey information, we have used tables, graphs, and bar charts heavily so that we expect the reader will need minimal accompanying text. For organizational convenience, our study material is presented in the sections that are described below. Because a large portion of the material is not exclusively related to a single section, its placement represents our judgment of the best fit.

S&E Workforce. We first identify the labs and describe their S&E populations, their RDT&E budgets, and their division of RDT&E performed in-house and contracted out. We look next at then-and-now distributions of S&E by type of work, job, grade, and discipline. High-grade S&E, part-time and temporary S&E, and on-base contract S&E are then examined. Some comparisons of lab S&E and national S&E are then followed by trends over the 1978-1986 period in various S&E workforce descriptors, viz., education level, length of service, age, grade, sex, minorities, employment levels, and retirement eligibility.

S&E Help Wanted. Here we describe the number and distribution of S&E billets that are authorized but unfilled because of unavailability of qualified S&E (vacancies) and the needs for more S&E than are currently authorized (shortages). We then examine shortages in multidisciplinary skills, which are not identified by the Federal system for coding occupational fields.

Recruitment. After identifying sources, viz., promotions or hires and transfers, of S&E to fill lab openings, this section looks at the effect of foreign enrollment in U.S. university curricula on the manpower pool of advanced-degree graduates available to DoD. Recruiting activities and programs are then compared, after which the reasons recruits accept or reject DoD lab employment are examined. After looking at job-offer rejection statistics and class standings of new hires, this section ends with an examination of time lapses in the S&E hiring process.

Retention. With regard to retention, this section identifies S&E losses and reasons S&E leave the labs. Since promotions are a factor that affects retention, the section next considers promotion percentages by grade level. The remainder of this section is devoted to causes and consequences of policies and practices that affect the ability of labs to retain their S&E.

Training. This section describes the nature of training activities, the time devoted to them, and difficulties that hinder training.

Senior Executive Service (SES). Here we let the lab directors assess the SES system, which was a questionnaire topic that directors were asked to discuss.

Pay. Annual pay of DoD lab S&E is compared to pay of S&E outside the labs from salary surveys by the following organizations: the National Science Foundation (NSF), the U.S. Bureau of Labor Statistics (BLS), the American Institute of Physics (AIP), the Institute of Electrical and Electronics Engineers (IEEE), the National Society of Professional Engineers (NSPE), the U.S. Department of Energy (DOE), and the Engineering Manpower Commission (EMC) of the American Association of Engineering Societies. Pay comparisons involve only salaries; they do not consider retirement pay, vacations, sick leave, insurance, or other fringe benefits that would be included in a comparison of total compensation.

The NSF data pertains to average salaries without regard to education, experience, or any other measure of S&E quality. The BLS data enabled us to compare average salaries of engineers (only) distributed by level of responsibility and its equivalent Federal GS grade level system.

Salary survey data from the AIP, IEEE, and NSPE enabled us to compare the pay of lab S&E stratified by several separate measures of quality--education level, age, grade level, and length of service--with national S&E who are similarly stratified. And these professional society data enable us to compare percentile salaries as well as average salaries. However, we have two concerns with use of professional society standards for pay-comparability analyses. Our first concern is our lack of knowledge about the comparability of the lab S&E population and the professional society populations. Our second concern is that society members are polled and their statements about pay are not subjected to validity checks.

The DOE and EMC salary data, like that of NSF and BLS, are provided from pay records of organizations surveyed. The DOE and EMC data bases enable us to analyze pay comparability--average and percentile salaries--by education level and maturity (years since receipt of bachelor's degree) for supervisory and for nonsupervisory S&E. The DOE data base has an additional attraction: salary data pertain to S&E involved in R&D activities.

Benefits. In this last chapter we summarize findings of three 1980s studies that compared pensions and other benefits for Federal workers with similar benefits available in the private sector.

NOTES: 1. Unless labeled "calendar" or "CY", we mean "fiscal year" whenever we relate data to a year throughout this report.
2. Whenever we talk about salaries, we mean "yearly salaries".

CHART I-1. SCIENTISTS AND ENGINEERS

JOB CODE	FIELD	JOB CODE	FIELD
	SCIENTISTS		SCIENTISTS (Continued)
101	SOCIAL SCIENCE	601	GENERAL HEALTH
150	GEOGRAPHY	602	MEDICAL OFFICER
180	PSYCHOLOGY	660	PHARMACIST
184	SOCIOLOGY	662	OPTOMETRIST
190	GENERAL ANTHROPOLOGY	665	SPEECH PATHOLOGY AND AUDIOLOGY
193	ARCHEOLOGY	668	PODIATRIST
		680	DENTAL OFFICER
401	GENERAL BIOLOGY	690	INDUSTRIAL HYGIENE
403	MICROBIOLOGY	696	CONSUMER SAFETY
405	PHARMACOLOGY		
408	ECOLOGY	701	VETERINARY MEDICAL SCIENCE
410	ZOOLOGY		
413	PHYSIOLOGY	1221	PATENT ADVISOR
414	ENTOMOLOGY	1223	PATENT CLASSIFYING
430	BOTANY	1225	PATENT INTERFERENCE EXAMINING
434	PLANT PATHOLOGY	1226	DESIGN PATENT EXAMINING
435	PLANT PHYSIOLOGY		
436	PLANT PROTECTION AND QUARANTINE	1301	PHYSICAL SCIENCE
437	HORTICULTURE	1306	HEALTH PHYSICS
440	GENETICS	1310	PHYSICS
454	RANGE CONSERVATION	1313	GEOPHYSICS
457	SOIL CONSERVATION	1315	HYDROLOGY
460	FORESTRY	1320	CHEMISTRY
470	SOIL SCIENCE	1321	METALLURGY
471	AGRONOMY	1330	ASTRONOMY AND SPACE SCIENCE
480	GENERAL FISH AND WILDLIFE	1340	METEOROLOGY
482	FISHERY BIOLOGY	1350	GEOLOGY
486	WILDLIFE BIOLOGY	1360	OCEANOGRAPHY
487	HUSBANDRY	1370	CARTOGRAPHY
493	HOME ECONOMICS	1372	GEODESY

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CHART I-1. SCIENTISTS AND ENGINEERS (Continued)

JOB CODE	FIELD	JOB CODE	FIELD
	SCIENTISTS (Continued)		ENGINEERS
1380	FOREST PRODUCTS TECHNOLOGY	801	GENERAL ENGINEERING
1382	FOOD TECHNOLOGY ACTUARY	803	SAFETY ENGINEERING
1384	TEXTILE TECHNOLOGY	804	FIRE PREVENTION ENGINEERING
1386	PHOTOGRAPHIC TECHNOLOGY	806	MATERIALS ENGINEERING
		807	LANDSCAPE ARCHITECTURE
1510	ACTUARY	808	ARCHITECTURE
1515	OPERATIONS RESEARCH	810	CIVIL ENGINEERING
1520	MATHEMATICS	819	ENVIRONMENTAL ENGINEERING
1529	MATHEMATICAL STATISTICIAN	830	MECHANICAL ENGINEERING
1530	STATISTICIAN	840	NUCLEAR ENGINEERING
1540	CRYPTOGRAPHY	850	ELECTRICAL ENGINEERING
1550	COMPUTER SCIENCE	855	ELECTRONICS ENGINEERING
		858	BIOMEDICAL ENGINEERING
		861	AERONAUTICS ENGINEERING
		871	NAVAL ARCHITECTURE
		880	MINING ENGINEERING
		881	PETROLEUM ENGINEERING
		890	AGRICULTURE ENGINEERING
		892	CERAMIC ENGINEERING
		893	CHEMICAL ENGINEERING
		894	WELDING ENGINEERING
		896	INDUSTRIAL ENGINEERING

II. S&E WORKFORCE

II. S&E WORKFORCE

A. THE LABS AND THEIR S&E POPULATIONS

The 66 Army (35), Navy (20), and Air Force (11) labs are shown in Chart II-1 with their civilian and military S&E populations, which are aggregated by Service in Chart II-2. While we sent survey questionnaires to 35 Army labs, all of which completed them, the Army would say that it has 29 labs. In conducting our survey, we were not aware that four Army centers--viz., the Electronics Warfare/Reconnaissance, Surveillance, and Target Acquisition Center (lab 8); the Night Vision and Electro-Optics Center (lab 15); the Signal Warfare Center (lab 17); and the Communications/Automated Data Processing Center (lab 35)--had become parts of the Army's Communications-Electronics RDE Center (lab 6) at the beginning of FY 1986. The responses from these five centers did not make us aware of the reorganization. So we treat them as five separate labs while the Army would consider them a single lab.

And somewhat similarly, we sent survey questionnaires to three Army activities--viz., the Avionics R&D Activity (lab 3); the Aviation Research and Technology Activity (lab 16); and the Aviation Engineering Flight Activity (lab 33)--which are components of the Army's Aviation RDE Center, which itself is not listed as a lab. So while the Army would consider the Center a single lab, we treat the physically-separated component activities as three labs.

Civilian S&E populations are shown from lab responses to our survey questionnaires and from DMDC. Because some labs were very late in completing the questionnaires, we used DMDC data to compute aggregate population statistics. After patience and prodding brought an eventual 100-percent lab response, we found that, despite marked percentage differences in S&E populations submitted by some labs and the corresponding populations of those labs (Army labs 1, 6, 8, 12, 15, 17, 18, 19, and 35; Navy lab 47; and Air Force lab 65 from Chart II-1) from DMDC files, the aggregate populations from the survey and from DMDC were similar. So we did not revise aggregate-population statistics computed without inputs from the late-responding labs.

In those cases where statistical computations are related to individual lab S&E populations, we used source data (survey or DMDC) that were most consistent with populations in years prior to 1986. A practical purpose for showing the individual lab populations from the survey and from DMDC is to spur a review of S&E record keeping at "large-difference" labs, which would expectedly want to ensure that accurate S&E data for their labs are on file at DMDC. These large differences in S&E populations exist even after we asked the labs and DMDC to verify their numbers.

Most of the S&E population differences between (reports from) the Army labs and the DMDC are associated with labs involved in the reorganization mentioned above. Although our investigation of the S&E differences was unable to reconstruct past lab personnel reports submitted by the Army to DMDC, we deduced that instead of crediting lab 6, the Communications-Electronics RDE Center, with the S&E complements of labs 8, 15, 17, and 35, lab 1, the Armament RDE Center, was credited with the S&E of those four labs and with the S&E of lab 6 as well. Our investigation covered DMDC, which verified data submissions from the Army; the Department of the Army Civilian Personnel Information Directorate, which submits Army personnel data to DMDC; and the Army Materiel Command, which formulates personnel data reports for Army labs.

Because some military S&E are thought to be "lost" when DMDC converts Service occupation codes to a single DoD coding system, the survey is our source for data on military S&E populations in the labs.

Chart II-3 shows the lab distribution by region and Chart II-4 shows lab distribution by size of the S&E workforce.

B. LAB RDT&E BUDGETS

Chart II-5 shows that while the Air Force's lab S&E workforce decreased by seven percent since 1981, Army labs increased their S&E by five percent, and Navy labs increased their S&E by 27 percent. The combined 13-percent growth in S&E workforce for all labs is substantially less than the combined RDT&E budget growth of 37 percent since 1981. In terms of constant 1986 dollars, Chart II-5 also shows that lab RDT&E budgets grew by 45 percent for the Army in five years, 19 percent for the Navy, and 51 percent for the Air Force.

Chart II-6 shows percentages of RDT&E work, on a dollar basis, that is contracted out by the labs. Chart II-7 gives a lab-by-lab breakdown of total RDT&E funding and in-house RDT&E funding. Army labs and Air Force labs increased the percentages of RDT&E work contracted out between 1981 and 1986 from 58 to 62 and 77 to 82, respectively, while Navy labs contracted out 43 percent in both years.

C. THEN-AND-NOW DISTRIBUTIONS OF S&E

Chart II-8 summarizes civilian and military S&E by Service labs for 1981 and 1986. We see that an overall increase of five percent in lab scientists was driven by a 20 percent increase in the Navy while the Army reduced its lab scientists by three percent and the Air Force reduced its lab scientists by 18 percent. And we see that an 18 percent increase in all-labs engineers reflects a 12 percent increase for the Army, a 30 percent increase for the Navy, and a one percent decrease for the Air Force. Over the five-year period, the Air Force labs have reduced their employment of military S&E, which they depend on much more than the Army and the Navy, by almost 25 percent.

Chart II-9 shows that about one third of military S&E are still assigned to medical and human resources labs with the other two-thirds distributed among the hardware labs. Chart II-8 highlights the increases in military S&E in Army labs (eight percent) and Navy labs (13 percent) compared to the 24 percent decrease in Air Force labs.

Charts II-10 and II-11 show the allocation of S&E manpower by type work and by type job, respectively. A noteworthy change over five years in Chart II-10 is the reduction of S&E allocated to Tech Base work--from 45 percent to 37 percent (18 percent decrease). The overall decrease in Tech Base work is driven by a 28 percent decrease in the Navy labs. Also noteworthy is the overall increased allocation--from 22 percent to 28 percent (27 percent increase)--of S&E to System Development; this overall increase is driven by increases of 44 percent and 17 percent in the Army and the Navy, respectively, while the Air Force allocation to System Development declined by 47 percent.

The most noteworthy allocation change in Chart II-11 is the growth in support-type jobs from none in 1981 to nine percent for all labs five years later. But this change might be illusory inasmuch as "Support" was not a job-type category in the 1981 survey; sharp decreases in Navy (21 percent to 12 percent) and Air Force (33 percent to 23 percent) allocations of S&E to "Contract Monitoring" suggest that that category may well have included some "Support" manpower in 1981.

Chart II-12 indicates that the percentage gain in the GS 9-12 S&E workforce from 1981 to 1986 was balanced by a corresponding percentage reduction in the GS 13-15 population.

Chart II-13 shows a reduction in physical scientists since 1981 and a sharp growth in computer scientists. The chart also indicates that most of the increase in the engineering population is due to the larger numbers of EEs and mechanical engineers.

D. HIGH-GRADE S&E

Chart II-14 shows high-grade (GS 13-15) S&E populations lab by lab. Chart II-15 shows that in both 1986 and 1981 high-grade percentages (of lab S&E populations) vary widely among the labs.

E. PART-TIME AND TEMPORARY S&E

Charts II-16, -17, and -18 provide aggregate data on part-time S&E. Comparable data were not collected in the 1981 survey for part-time or temporary S&E other than co-op personnel. In Chapter IV (Recruitment) we will see that co-op programs are a superior source for developing full-time, permanent S&E from part-time or temporary S&E employees.

F. CONTRACT S&E ON BASE

Charts II-19 and II-20 show the number of contract S&E working on base in 1986. Chart II-19 summarizes this part of the workforce by Service; lab by lab details are provided by Chart II-20.

Chart II-20 indicates that on-base contract S&E, which were not examined in the earlier lab survey, constitute one-third or more of the total on-base S&E populations at 11 labs--seven Army, three Navy, and one Air Force.

An interesting, but unproductive, investigation involves (1) the percentage of RDT&E work performed by on-base contractors (Chart II-6) and (2) on-base S&E as a percentage of total S&E on base (lab S&E in Chart II-2 plus contractor S&E in Chart II-20). The comparison shows that on-base contractors accounted for much larger percentages of the labs' on-base S&E workforce--i.e., civilian-, military-, and contract-S&E--than did the percentages of dollar-based contractor work conducted on base in 1986. A logical next step in the investigation is to compare the cost per scientist or engineer (S/E) employed by on-base contractors with the cost of an in-house S/E. Data already presented--viz., (1) number of S&E on base belonging to contractors and to the labs, (2) total RDT&E budget, and (3) fraction of RDT&E budget used to support on-base contractors--appear to invite such a comparison. The comparison is invalid because appropriations other than RDT&E fund in-house lab work and/or on-base contractors are often a quicker and less troublesome means than in-house procurement channels to purchase needed lab equipment.

G. LAB S&E COMPARED TO NATIONAL S&E

Recent examination of the National Science Foundation (NSF) system for collecting and analyzing data pertaining to national S&E indicate that NSF estimates are substantially different from estimates based on other data systems. Because the credibility of the NSF data system is presently an issue, we also use a national S&E estimate from another data system for each comparison.

In Chart II-21 we see substantially different 1981-1986 growth rates in the national S&E population as estimated by the National Science Foundation (39 percent) and the Bureau of Labor Statistics (3 percent). During the same five years, the DoD-wide S&E population grew by 21 percent and DoD lab S&E employment grew by 13 percent.

Chart II-22 shows that the lab S&E workforce continues to be heavily weighted by engineers--even more so than the national S&E workforce. Here we see that physical scientists and mathematicians account for 70 percent of DoD lab scientists in 1986, a 10-percent decline since 1981, while EEs and mechanical engineers continue to account for nearly two-thirds of all DoD lab engineers. Both proportions are substantially greater than the proportions of national S&E in these fields.

While the S&E distributions by discipline are similar in Charts II-13 and II-22, the differences are attributable to (1) a difference in data sources, i.e., DMDC and our survey, and (2) the fact that not all labs responded to all survey questions. Thus, while DMDC figures pertain to all lab S&E, survey statistics pertain to the S&E population of the responding labs.

Chart II-23 shows that the distribution of civilian S&E by education level in the DoD labs closely matches the national distribution estimated by the National Science Foundation but less closely than the alternative national estimate.

H. TRENDS IN VARIOUS S&E WORKFORCE DESCRIPTORS

1. Education

In Chart II-24 we see that the distribution of civilian S&E by education level has remained almost constant over the 1978-1986 period.

2. Length of Service and Age

Chart II-25 shows that the 1986 S&E population in the one-to-eight-years-LOS group greatly exceeds the corresponding 1981 population. We also see in Chart II-26 that in 1986 S&E with more than 35 years LOS also exceeds, but not so greatly, the corresponding group five years earlier. Charts II-26 and II-27 show average age and average length of service (LOS) trends over the 1978-1986 period, during which the overall (all labs) average age has declined one year and the overall average LOS has declined by a little more than one year. Chart II-27 indicates that the average age of civilian S&E in the Navy and Air Force labs declined about one year during the 1987-1986 period, while the average age of the Army lab S&E rose fractionally over that period. Chart II-27 also indicates that average LOS declined about one year over the 1978-1986 period for Army and Navy S&E, while the average LOS of the Air Force labs' S&E workforce stayed about the same.

3. Grade

Charts II-28 through 30 are concerned with grade distributions. In these charts, we see no dramatic changes in grade distribution or average grade since 1981 or, for that matter, over the 1978-1986 period.

4. Women and Minorities

Charts II-31 and II-32 show steady growth in the employment of women and minorities as percentages of the lab S&E workforce over the 1978-1986 period. Chart II-31 indicates that the rate of increase of women as a percentage of the S&E workforce has kept pace with corresponding national percentages, which, throughout the 1978-1986 period, have been about five percent above the DoD lab percentages. And Chart II-31 indicates that national and DoD-lab increases in minority S&E percentages have not been as marked as those for women over the 1978-1986 period and that the minority S&E employment percentage for the labs in 1986 is very close to the national percentage.

5. Employment and Retirement Eligibility

Chart II-33 shows modest growth trends of civilian S&E and total lab workforce over the 1978-1986 periods.

Chart II-34 shows retirement eligibility of civilian S&E over the 1978-1988 period. In 1988, over eight percent of lab S&E were eligible to retire by virtue of age and length of service. And in 1988, over 17 percent were in age-LOS categories that made them eligible for "early-out" retirement if base closing, reduction in force, or other action caused their jobs to be discontinued; this potential early-out population has grown steadily from less than 14 percent a decade earlier.

Chart II-35 shows that the percentage of S&E eligible for normal retirement has grown from seven percent in 1978 to over eight percent in 1988. The 1988 data--2,213 retirement-eligibles in an S&E population of 26,870--was provided by DMDC in a special data run.

CHART II-1. DoD LABS AND THEIR S&E, 1986

ARMY	CIVILIAN SURVEY	S&E DMDC	MILITARY S&E
1. Armament RDE Center, Dover, NJ	682	1,848[a]	17
2. Atmospheric Sciences Lab, White Sands Missile Range, NM	133	131	3
3. Avionics R&D Activity, Ft. Monmouth, NJ	157	155	10
4. Ballistic Research Lab, Aberdeen PG, MD	447	433	11
5. Chemical RDE Center, Aberdeen PG, MD	650	651	41
6. Communications-Electronics RDE Center, Ft. Monmouth, NJ	313	0[a]	5
7. Electronics Technology & Devices Lab, Ft. Monmouth, NJ	186	199	1
8. Electronics Warfare/Reconnaissance, Surveillance, and Target Acquisition Center, Ft. Monmouth, NJ	192	2[a]	0
9. Harry Diamond Labs, Adelphi, MD	421	446	3
10. Human Engineering Lab, Aberdeen PG, MD	109	122	0
11. Materials Technology Lab, Watertown, MA	256	239	6
12. Missile Command, Redstone Arsenal, AL	739	1,101	5

[a] INVESTIGATION INDICATES THAT IN SUBMITTING LAB PERSONNEL REPORTS TO DMDC FOR 1986, THE ARMY MISTAKENLY CREDITED LAB 1 WITH S&E COMPLEMENTS OF LABS 6, 8, 15, 17, AND 35.

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CHART II-1. DoD LABS AND THEIR S&E, 1986 (Continued)

	ARMY	CIVILIAN S&E SURVEY	CIVILIAN S&E DMDC	MILITARY S&E
13.	Belvoir RDE Center, Ft. Belvoir, VA	427	420	5
14.	Natick RDE Center, Natick, MA	383	400	24
15.	Night Vision & Electro-Optics Center, Ft. Belvoir, VA	270	0[a]	3
16.	Aviation Research & Technology Activity, Moffett Field, CA	275	259	10
17.	Signals Warfare Center, Warrenton, VA	77	2[a]	0
18.	Tank-Automotive RDE Center, Warren, MI	370	240	25
19.	Army Research Institute, Alexandria, VA	219	122	0
20.	Cold Regions R&E Lab, Hanover, NH	120	119	0
21.	Construction Engineering Research Lab, Champaign, IL	155	137	3
22.	Engineer Topographic Labs, Ft. Belvoir, VA	186	183	8
23.	Engineer Waterways Experiment Station, Vicksburg, MS	684	658	20
24.	Aeromedical Research Lab, Ft. Rucker, AL	20	19	15

[a] INVESTIGATION INDICATES THAT IN SUBMITTING LAB PERSONNEL REPORTS TO DMDC FOR 1986, THE ARMY MISTAKENLY CREDITED LAB 1 WITH S&E COMPLEMENTS OF LABS 6, 8, 15, 17, AND 35.

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CHART II-1. DoD LABS AND THEIR S&E, 1986 (Continued)

	ARMY	CIVILIAN S&E SURVEY	CIVILIAN S&E DMDC	MILITARY S&E
25.	Institute for Dental Research, Washington, DC	2	4	17
26.	Institute of Surgical Research, Ft. Sam Houston, TX	13	13	13
27.	Letterman Army Institute of Research, San Francisco, CA	32	35	31
28.	Biomedical R&D Lab, Frederick, MD	32	30	7
29.	Medical Research Institute of Chemical Defense, Aberdeen PG, MD	46	47	21
30.	Medical Research Institute of Infectious Diseases, Frederick, MD	.62	62	58
31.	Research Institute of Environmental Medicine, Natick, MA	47	46	15
32.	Walter Reed Army Institute of Research, Washington, DC	139	145	135
33.	Aviation Engineering Flight Activity, Edwards AFB, CA	29	29	1
34.	Vulnerability Assessment Lab, White Sands MR, NM	115	99	1
35.	Communications/Automated Data Processing Center, Ft. Monmouth, NJ	313	0[a]	3
	Army Labs Total	8,301	8,396	512

[a] INVESTIGATION INDICATES THAT IN SUBMITTING LAB PERSONNEL REPORTS TO DMDC FOR 1986, THE ARMY MISTAKENLY CREDITED LAB 1 WITH S&E COMPLEMENTS OF LABS 6, 8, 15, 17, AND 35.

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CHART II-1. DoD LABS AND THEIR S&E, 1986 (Continued)

	NAVY	CIVILIAN S&E SURVEY	CIVILIAN S&E DMDC	MILITARY S&E
36.	Naval Research Lab, Washington, DC	1,461	1,393	3
37.	Naval Ocean Research & Development Activity, Bay St. Louis, MS	167	176	11
38.	Naval Environmental Prediction Research Facility, Monterey, CA	26	26	4
39.	David W. Taylor Naval Ship R&D Center, Bethesda, MD	1,365	1,324	4
40.	Naval Air Development Center, Warminster, PA	1,523	1,528	21
41.	Naval Coastal Systems Center, Panama City, FL	577	576	1
42.	Naval Ocean Systems Center, San Diego, CA	1,549	1,549	35
43.	Navy Personnel Research & Development Center, San Diego, CA	175	168	4
44.	Naval Surface Weapons Center, Dahlgren, VA	2,430	2,469	17
45.	Naval Underwater Systems Center, Newport, RI	1,924	1,929	18
46.	Naval Weapons Center, China Lake, CA	1,818	1,863	6
47.	Naval Medical Research Institute, Bethesda, MD	75	51	57
48.	Naval Submarine Medical Research Lab, New London, CT	33	25	12

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CHART II-1. DoD LABS AND THEIR S&E, 1986 (Continued)

	NAVY	CIVILIAN S&E SURVEY	CIVILIAN S&E DMDC	MILITARY S&E
49.	Naval Health Research Center, San Diego, CA	27	28	12
50.	Naval Dental Research Institute, Great Lakes, IL	7	6	7
51.	Naval Aerospace Medical Research Lab, Pensacola, FL	34	25	16
52.	Naval Biodynamics Lab, New Orleans, LA	16	17	7
53.	Naval Air Propulsion Center, Trenton, NJ	201	208	0
54.	Naval Civil Engineering Lab, Port Hueneme, CA	213	213	7
55.	Naval Clothing and Textile Research Facility, Natick, MA	31	34	0
	Navy Labs Total	13,652	13,608	242

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CHART II-1. DoD LABS AND THEIR S&E, 1986 (Continued)

AIR FORCE	CIVILIAN SURVEY	S&E DMDC	MILITARY S&E
56. Air Force Wright Aeronautical Labs, Wright-Patterson AFB, OH	1,289	1,289	282
57. AF Armstrong Aerospace Medical Research Lab, Wright-Patterson AFB, OH	89	92	57
58. AF Armament Test Lab, Eglin AFB, FL	232	210	73
59. AF Engineering Services Lab, Tyndall AFB, FL	57	55	27
60. AF Geophysics Lab, Hanscom AFB, MA	255	253	52
61. AF Human Resource Lab, Brooks AFB, TX	110	92	83
62. AF Astronautics Lab, Edwards AFB, CA	130	118	56
63. Rome Air Development Center, Griffiss AFB, NY	570	610	133
64. AF Weapons Lab, Kirtland AFB, NM	198	212	188
65. Frank Seiler Research Lab, USAF Academy, CO	3	30	18
66. USAF School of Aerospace Medicine, Brooks AFB, TX	98	100	0
Air Force Labs Total	3,031	3,061	969
All Labs Total	24,984	25,065	1,723

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CHART II-2. LAB S&E TOTALS, END OF 1986

	CIVILIAN		MILITARY[a]	SURVEY CIVILIANS PLUS MILITARY	DMDC CIVILIANS PLUS MILITARY
	SURVEY	DMDC			
ARMY	8,301	8,396	512	8,813	8,908
NAVY	13,652	13,608	242	13,894	13,850
AIR FORCE	3,031	3,051	969	4,000	4,030
TOTAL	24,984	25,065	1,723	26,707	26,788

[a] CONVERTING SERVICE OCCUPATION CODES FOR MILITARY PERSONNEL TO THE SINGLE DoD CODING STRUCTURE USED BY DMDC RESULTS IN A SUBSTANTIAL NUMBER OF MILITARY S&E NOT BEING INCLUDED IN THE DMDC COUNT. TO AVOID THIS CONVERSION LOSS, MILITARY S&E DATA ARE TAKEN FROM THE SURVEY, IN WHICH THE LABS USED THEIR SERVICE OCCUPATIONS CODING SYSTEMS.

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CHART II-3. DoD LAB REGIONAL LOCATIONS

REGION	ARMY		NAVY		AIR FORCE		ALL LABS	
	1981	1986	1981	1986	1981	1986	1981	1986
NORTHEAST (MA, NH, RI, NY)	5	4	3	3	2	2	10	9
DC METROPOLITAN AREA	8	7	4	4	0	0	12	11
MIDATLANTIC (NJ, PA, MD, VA)	16	13	2	2	0	0	18	15
SOUTH (FL, AL, MS, LA)	3	3	4	4	2	2	9	9
MIDWEST (OH, IL, MI)	3	2	1	1	2	2	6	5
WEST (TX, NM, CA, CO)	4	6	7	6	5	5	16	17
TOTALS	39	35	21	20	11	11	71	66

SOURCE: REF. 1 FOR 1981 AND SURVEY FOR 1986.

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11/8/88

CHART II-4. DoD LABS DISTRIBUTED BY SIZE OF CIVILIAN S&E WORKFORCE

NUMBER OF CIVILIAN S&E	ARMY 1981	ARMY 1986	NAVY 1981	NAVY 1986	AIR FORCE 1981	AIR FORCE 1986	ALL LABS 1981	ALL LABS 1986
ALL TYPES OF LABS								
100 OR FEWER	15	10	9	8	3	4	27	22
101-499	21	21	5	4	6	5	32	30
500-999	2	4	0	1	1	1	3	6
1000 OR MORE	1	0	7	7	1	1	9	8
MEDICAL AND HUMAN RESOURCE LABS								
100 OR FEWER	10	9	8	6	1	2	19	17
101-499	3	2	1	1	2	1	6	4
500-999	0	0	0	0	0	0	0	0
1000 OR MORE	0	0	0	0	0	0	0	0

SOURCE: REF. 1 FOR 1981 AND SURVEY QUESTION 11 FOR 1986.

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CHART II-5. DoD LABS WORKFORCE AND BUDGET

			ARMY		NAVY		AIR FORCE		ALL LABS	
			1981	1986	1981	1986	1981	1986	1981	1986
NUMBER OF LABS			39		21		11		71	
				35		20		11		66
TOTAL WORKFORCE[a]			21,938		23,975		5,765		51,678	
				21,754		28,446		5,466		55,666
TOTAL S&E WORKFORCE[b]			8,393		10,967		4,328		23,688	
				8,908		13,850		4,030		26,788
TOTAL RDT&E BUDGET, $B[c]	1981	FY-81 $	1.36		1.54		0.99		3.89	
		FY-86 $[d]	1.65		1.85		1.19		4.69	
	1986	FY-86 $		2.40		2.21		1.80		6.41

[a] 1981 DATA FROM EARLIER SURVEY (REF. 1); 1986 WORKFORCE DATA FROM DMDC.

[b] SOURCE: REF. 1 FOR 1981 AND SURVEY QUESTION 11 FOR 1986.

[c] SOURCES: 1981 AND 1986 DoD IN-HOUSE RDT&E ACTIVITIES REPORTS (REFS. 2 AND 3).

[d] 1981 DOLLARS MULTIPLIED BY 1.21 TO REFLECT 5-YEAR INFLATION AS INDICATED BY CONSUMER PRICE INDEXES OF THE BUREAU OF LABOR STATISTICS.

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11/8/88

CHART II-6. PERCENTAGE OF THE DOLLAR-VALUE OF RDT&E WORK CONTRACTED OUT BY DoD LABS

LABS	TOTAL		ON-BASE[c] 1986
	1981[a]	1986[b]	
ARMY	58	62	6.8
NAVY	43	43	4.4
AIR FORCE	77	82	9.3
ALL LABS	57	61	6.2

[a] SOURCE: 1981 DoD IN-HOUSE RDT&E ACTIVITIES REPORT (REF. 2).

[b] SOURCE: 1986 DoD IN-HOUSE RDT&E ACTIVITIES REPORT (REF. 3).

[c] PERCENTAGE OF TECHNICAL CONTRACT WORK THAT IS CONDUCTED ON BASE. SOURCE: SURVEY QUESTION 9. NO COMPARABLE 1981 DATA.

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11/9/88

CHART II-7. IN-HOUSE LAB RDT&E IN 1986[a]

ARMY	TOTAL RDT&E $M	IN-HOUSE RDT&E $M	RATIO OF IN-HOUSE RDT&E TO TOTAL RDT&E
1. Armament RDE Center	324.800	162.400	0.50
2. Atmospheric Sciences Lab	43.024	25.538	0.59
3. Avionics R&D Activity	21.234	11.626	0.55
4. Ballistic Research Lab	119.199	50.745	0.43
5. Chemical RDE Center	139.371	62.569	0.45
6. Communications-Electronics RDE Center	b	b	b
7. Electronics Technology & Devices Lab	89.221	16.359	0.18
8. Electronics Warfare/Reconnaissance, Surveillance, and Target Acquisition Center	85.554	8.462	0.10
9. Harry Diamond Labs	105.794	32.296	0.31
10. Human Engineering Lab	21.688	13.230	0.61
11. Materials Technology Lab	48.234	33.891	0.70
12. Missile Command	217.641	54.393	0.25

[a] SOURCE: 1986 DoD IN-HOUSE RDT&E ACTIVITIES REPORT (REF. 3).

[b] FUNDING APPORTIONED AMONG FOUR CENTER COMPONENTS--VIZ., LABS 8, 15, 17, AND 35--OF THE PARENT COMMUNICATIONS-ELECTRONICS RDE CENTER.

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CHART II-7. IN-HOUSE LAB RDT&E IN 1986 (Continued)

	ARMY	TOTAL RDT&E $M	IN-HOUSE RDT&E $M	RATIO OF IN-HOUSE RDT&E TO TOTAL RDT&E
13.	Belvoir RDE Center	140.233	39.504	0.28
14.	Natick RDE Center	65.924	41.554	0.63
15.	Night Vision & Electro-Optics Center	127.927	35.190	0.28
16.	Aviation Research & Technology Activity	100.560	37.305	0.37
17.	Signals Warfare Center	56.718	4.297	0.08
18.	Tank-Automotive RDE Center	110.183	22.959	0.21
19.	Army Research Institute	67.747	22.941	0.34
20.	Cold Regions R&E Lab	12.338	7.773	0.63
21.	Construction Engineering Research Lab	31.288	18.773	0.60
22.	Engineer Topographic Labs	62.954	15.662	0.25
23.	Engineer Waterways Experiment Station	60.524	42.214	0.70
24.	Aeromedical Research Lab	6.875	6.032	0.88

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CHART II-7. IN-HOUSE LAB RDT&E IN 1986 (Continued)

ARMY	TOTAL RDT&E $M	IN-HOUSE RDT&E $M	RATIO OF IN-HOUSE RDT&E TO TOTAL RDT&E
25. Institute for Dental Research	4.353	2.263	0.52
26. Institute of Surgical Research	3.450	3.450	1.00
27. Letterman Army Institute of Research	18.128	11.144	0.61
28. Biomedical R&D Lab	10.973	5.919	0.54
29. Medical Research Institute of Chemical Defense	28.177	15.375	0.55
30. Medical Research Institute of Infectious Diseases	42.122	21.609	C.51
31. Research Institute of Environmental Medicine	7.258	6.324	0.87
32. Walter Reed Army Institute of Research	104.118	42.912	0.41
33. Aviation Engineering Flight Activity	8.040	7.195	0.89
34. Vulnerability Assessment Lab	49.306	13.783	0.28
35. Communications/Automated Data Processing Center	69.746	22.426	0.32
Army Labs Total	2,404.703	918.113	0.38

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CHART II-7. IN-HOUSE LAB RDT&E IN 1986 (Continued)

NAVY	TOTAL RDT&E $M	IN-HOUSE RDT&E $M	RATIO OF IN-HOUSE RDT&E TO TOTAL RDT&E
36. Naval Research Lab	251.700	164.586	0.65
37. Naval Ocean Research & Development Activity	41.662	20.819	0.50
38. Naval Environmental Prediction Research Facility	6.540	2.673	0.41
39. David W. Taylor Naval Ship R&D Center	218.385	145.577	0.67
40. Naval Air Development Center	266.762	129.253	0.48
41. Naval Coastal Systems Center	75.326	48.269	0.64
42. Naval Ocean Systems Center	302.231	135.584	0.45
43. Naval Personnel Research & Development Center	21.494	15.418	0.72
44. Naval Surface Weapons Center	348.588	178.870	0.51
45. Naval Underwater Systems Center	206.996	127.816	0.62
46. Naval Weapons Center	320.924	182.908	0.57
47. Naval Medical Research Institute	20.784	18.228	0.88
48. Naval Submarine Medical Research Lab	3.117	2.853	0.92

JM:kg-4
5/30/89

CHART II-7. IN-HOUSE LAB RDT&E IN 1986 (Continued)

NAVY	TOTAL RDT&E $M	IN-HOUSE RDT&E $M	RATIO OF IN-HOUSE RDT&E TO TOTAL RDT&E
49. Naval Health Research Center	4.184	2.782	0.66
50. Naval Dental Research Institute	1.112	0.949	0.85
51. Naval Aerospace Medical Research Lab	7.184	7.184	1.00
52. Naval Biodynamics Lab	3.909	3.430	0.88
53. Naval Air Propulsion Center	67.939	41.855	0.62
54. Naval Civil Engineering Lab	33.227	19.576	0.59
55. Naval Clothing and Textile Research Facility	2.608	2.109	0.81
Navy Labs Total	2,204.672	1,250.739	0.57

JM:kg-5
5/30/89

CHART II-7. IN-HOUSE LAB RDT&E IN 1986 (Continued)

AIR FORCE	TOTAL RDT&E $M	IN-HOUSE RDT&E $M	RATIO OF IN-HOUSE RDT&E TO TOTAL RDT&E
56. Air Force Wright Aeronautical Labs	633.763	74.982	0.12
57. AF Armstrong Aerospace Medical Research Lab	29.898	10.663	0.36
58. AF Armament Test Lab	119.410	32.655	0.27
59. AF Engineering Services Lab	19.234	0.909	0.05
60. AF Geophysics Lab	108.432	32.503	0.30
61. AF Human Resource Lab	58.123	12.528	0.22
62. AF Astronautics Lab	99.487	18.593	0.19
63. Rome Air Development Center	367.289	59.462	0.16
64. AF Weapons Lab	334.565	66.913	0.20
65. Frank Seiler Research Lab	1.989	1.989	1.00
66. USAF School of Aerospace Medicine	29.898	10.663	0.36
Air Force Labs Total	1,802.088	321.860	0.18
All Labs Total	6,411.463	2,490.712	0.39

JM:kg-6
5/30/89

CHART II-8. CIVILIAN AND MILITARY S&E COMPONENTS

	ARMY		NAVY		AIR FORCE		ALL LABS	
	1981	1986	1981	1986	1981	1986	1981	1986
SCIENTISTS								
CIVILIAN	3,127	2,996	4,099	4,935	1,044	971	8,270	8,902
MILITARY	314	357	145	165	456	264	915	786
TOTAL	3,441	3,353	4,244	5,100	1,500	1,235	9,185	9,688
ENGINEERS								
CIVILIAN	4,837	5,400	6,654	8,673	2,006	2,090	13,497	16,163
MILITARY	115	155	69	77	822	705	1,006	937
TOTAL	4,952	5,555	6,723	8,750	2,828	2,795	14,503	17,100
S&E								
CIVILIAN	7,964	8,396	10,753	13,608	3,050	3,061	21,767	25,065
MILITARY	429	512	214	242	1,278	969	1,921	1,723
TOTAL	8,393	8,908	10,967	13,850	4,328	4,030	23,688	26,788
MILITARY S&E AS PERCENT OF ALL S&E								
	5	6	2	2	30	24	8	6

SOURCE: 1981 DATA FROM REF. 1; 1986 CIVILIAN DATA FROM DMDC (THE SURVEY INDICATES 81 FEWER S&E); 1986 MILITARY DATA FROM SURVEY QUESTION 11.

JM:kg-6A
11/8/88

CHART II-9. MILITARY S&E

LABS	ARMY		NAVY		AIR FORCE		TOTAL	
	1981	1986	1981	1986	1981	1986	1981	1986
ALL TYPES OF LABS	429		214		1,278		1,921	
		512		242		969		1,723
MEDICAL AND HUMAN RESOURCES LABS	300		109		226		635	
		312		115		158		585
PERCENT AT MEDICAL AND HUMAN RESOURCES LABS	70		51		18		33	
		61		48		16		34

SOURCE: 1981 DATA FROM REF. 1; 1986 DATA FROM SURVEY QUESTION 11.

JM:kg-9
11/8/88

CHART II-10. ALLOCATION OF S&E MANPOWER BY TYPE OF WORK, IN PERCENTAGES[a]

TYPE OF WORK	ARMY		NAVY		AIR FORCE		ALL LABS	
	1981	1986	1981	1986	1981	1986	1981	1986
TECH BASE	47	45	32	23	72	73	45	37
SYSTEM DEVELOPMENT	18	26	29	34	15	8	22	28
TEST & EVALUATION	5	6	7	6	1	4	5	6
PRODUCT SUPPORT	15	10	20	16	3	8	15	13
OTHER	15	13	12	21	9	7	13	16

[a] TYPE OF WORK WAS IMPLICITLY DEFINED IN THE SURVEYS BY THE QUESTIONNAIRES OFFERING THE FIVE CATEGORIES SHOWN; 1981 DATA FROM REF. 1; 1986 DATA FROM SURVEY QUESTION 6.

JM:kg-10
11/8/88

CHART II-11. ALLOCATION OF S&E MANPOWER BY TYPE OF JOB, IN PERCENTAGES[a]

TYPE OF JOB	ARMY		NAVY		AIR FORCE		ALL LABS	
	1981	1986	1981	1986[b]	1981	1986	1981	1986
BENCH WORK/"HANDS ON"	54	45	55	56	36	30	51	49
LINE MANAGEMENT	13	12	11	8	10	8	12	9
CONTRACT MONITORING	17	20	21	12	33	23	22	16
STAFF ADMINISTRATION	4	6	3	4	7	6	4	5
PLANNING	5	5	2	5	5	5	4	5
DIRECTOR/ADVISORY	3	5	2	2	2	18	2	5
SUPPORT	c	4	c	12	c	6	c	9
OUTSIDE	c	2	c	0	c	0	c	1
OTHER	4	1	6	0	7	4	5	1

[a] TYPE OF JOB WAS IMPLICITLY DEFINED IN THE SURVEYS BY THE QUESTIONNAIRES OFFERING THE CATEGORIES--NINE IN 1986 AND SEVEN IN 1981--SHOWN; 1981 DATA FROM REF. 1; 1986 DATA FROM SURVEY QUESTION 10.

[b] DUE TO ROUNDING, COLUMN TOTAL EQUALS 99%.

[c] DATA NOT COLLECTED IN 1981.

JM:kg-1.1
11/8/88

CHART II-12. GRADE DISTRIBUTION OF CIVILIAN S&E

GRADE	ARMY		NAVY		AIR FORCE		ALL LABS	
	1981	1986	1981	1986	1981	1986	1981	1986
GS 5-7	282	356	347	442	104	106	733	904
GS 9-12	3,743	4,117	5,564	7,314	1,040	979	10,347	12,410
GS 13-15	3,878	3,854	4,733	5,748	1,881	1,932	10,492	11,534
SES/16-18	61	65	109	97	25	41	195	203
CIVILIAN TOTAL	7,964	8,396	10,753	13,608	3,050	3,061	21,767	25,065
PERCENT 9-12	47.0	49.0	51.7	53.7	34.1	32.0	47.5	49.5
PERCENT 13-15	48.7	45.9	44.0	42.2	61.6	63.1	48.2	46.0

SOURCES: REF. 1 FOR 1981 AND DMDC FOR 1986.

JM:kg-15
11/8/88

CHART II-13. DISTRIBUTION OF DoD LAB S&E BY DISCIPLINE

DISCIPLINE	CIVILIAN[a]		MILITARY[b]	
	1981	1986	1981	1986
SCIENTISTS				
PHYSICS	3,303	2,477	364	59
CHEMISTRY	1,198	987		69
MATHEMATICS/STATISTICS	1,931	1,914	10	49
COMPUTER SCIENCE	275	1,036		87
OTHER	1,563	2,488	541	510
TOTAL	8,270	8,902	915	774
ENGINEERS				
ELECTRICAL/ELECTRONIC	5,916	6,882	256	343
MECHANICAL	2,663	3,602	283	96
AERONAUTICAL	1,364	1,498	250	179
GENERAL	1,893	2,013	18	107
OTHER	1,661	2,168	199	224
TOTAL	13,497	16,163	1,006	949
TOTAL S&E	21,767	25,065	1,921	1,723

[a] SOURCE: DMDC.
[b] SOURCE: REF. 1 FOR 1981 AND SURVEY QUESTION 11 FOR 1986.

JM:kg-12
11/8/88

CHART II-14. HIGH-GRADE S&E (GS 13-15), 1986

ARMY	NUMBER OF CIVILIAN S&E	HIGH-GRADE NUMBER	HIGH-GRADE PERCENT
1. Armament RDE Center, Dover, NJ	682	232	34
2. Atmospheric Sciences Lab, White Sands Missile Range, NM	133	55	41
3. Avionics R&D Activity, Ft. Monmouth, NJ	157	35	22
4. Ballistic Research Lab, Aberdeen PG, MD	447	232	52
5. Chemical RDE Center, Aberdeen PG, MD	650	267	41
6. Communications-Electronics RDE Center, Ft. Monmouth, NJ	313	138	44
7. Electronics Technology & Devices Lab, Ft. Monmouth, NJ	186	117	63
8. Electronics Warfare/Reconnaissance, Surveillance, and Target Acquisition Center, Ft. Monmouth, NJ	192	121	63
9. Harry Diamond Labs, Adelphi, MD	421	206	49
10. Human Engineering Lab, Aberdeen PG, MD	109	70	64
11. Materials Technology Lab, Watertown, MA	256	123	48
12. Missile Command, Redstone Arsenal, AL	739	436	59

SOURCE: SURVEY QUESTION 11.

JM:kg-16
11/8/88

CHART II-14. HIGH-GRADE S&E (GS 13-15), 1986
(Continued)

	ARMY	NUMBER OF CIVILIAN S&E	HIGH-GRADE NUMBER	HIGH-GRADE PERCENT
13.	Belvoir RDE Center, Ft. Belvoir, VA	427	222	52
14.	Natick RDE Center, Natick, MA	383	119	31
15.	Night Vision & Electro-Optics Center, Ft. Belvoir, VA	270	146	54
16.	Aviation Research & Technology Activity, Moffett Field, CA	275	160	58
17.	Signals Warfare Center, Warrenton, VA	77	45	58
18.	Tank-Automotive RDE Center, Warren, MI	370	204	55
19.	Army Research Institute, Alexandria, VA	219	120	55
20.	Cold Regions R&E Lab, Hanover, NH	120	64	53
21.	Construction Engineering Research Lab, Champaign, IL	155	51	33
22.	Engineer Topographic Labs, Ft. Belvoir, VA	186	71	38
23.	Engineer Waterways Experiment Station, Vicksburg, MS	684	280	41
24.	Aeromedical Research Lab, Ft. Rucker, AL	20	12	60

SOURCE: SURVEY QUESTION 11.

JM:kg-17
11/8/88

CHART II-14. HIGH-GRADE S&E (GS 13-15), 1986 (Continued)

	ARMY	NUMBER OF CIVILIAN S&E	HIGH-GRADE NUMBER	HIGH-GRADE PERCENT
25.	Institute of Dental Research, Washington, DC	2	1	50
26.	Institute of Surgical Research, Ft. Sam Houston, TX	13	2	15
27.	Letterman Army Institute of Research, San Francisco, CA	32	16	50
28.	Biomedical R&D Lab, Frederick, MD	32	17	53
29.	Medical Research Institute of Chemical Defense, Aberdeen PG, MD	46	24	52
30.	Medical Research Institute of Infectious Diseases, Frederick, MD	62	15	24
31.	Research Institute of Environmental Medicine, Natick, MA	47	12	26
32.	Walter Reed Army Institute of Research, Washington, DC	139	70	50
33.	Aviation Engineering Flight Activity, Edwards AFB, CA	29	17	59
34.	Vulnerability Assessment Lab, White Sands MR, NM	115	54	47
35.	Communications/Automated Data Processing Center, Ft. Monmouth, NJ	313	138	44
	Army Labs Total	8,301	3,892	47

SOURCE: SURVEY QUESTION 11.

JM:kg-18
11/8/88

CHART II-14. HIGH-GRADE S&E (GS 13-15), 1986 (Continued)

NAVY	NUMBER OF CIVILIAN S&E	HIGH-GRADE NUMBER	HIGH-GRADE PERCENT
36. Naval Research Lab, Washington, DC	1,461	964	66
37. Naval Ocean Research & Development Activity, Bay St. Louis, MS	167	105	63
38. Naval Environmental Prediction Research Facility, Monterey, CA	26	14	54
39. David W. Taylor Naval Ship R&D Center, Bethesda, MD	1,365	573	42
40. Naval Air Development Center, Warminster, PA	1,523	548	36
41. Naval Coastal Systems Center, Panama City, FL	577	173	30
42. Naval Ocean Systems Center, San Diego, CA	1,549	728	47
43. Navy Personnel Research & Development Center, San Diego, CA	175	68	39
44. Naval Surface Weapons Center, Dahlgren, VA	2,430	923	38
45. Naval Underwater Systems Center, Newport, RI	1,924	654	34
46. Naval Weapons Center, China Lake, CA	1,818	764	42
47. Naval Medical Research Institute, Bethesda, MD	75	30	40
48. Naval Submarine Medical Research Lab, New London, CT	33	10	30

SOURCE: SURVEY QUESTION 11.

JM:kg-19
11/8/88

CHART II-14. HIGH-GRADE S&E (GS 13-15), 1986
(Continued)

NAVY	NUMBER OF CIVILIAN S&E	HIGH-GRADE NUMBER	HIGH-GRADE PERCENT
49. Naval Health Research Center, San Diego, CA	27	10	37
50. Naval Dental Research Institute, Great Lakes, IL	7	2	29
51. Naval Aerospace Medical Research Lab, Pensacola, FL	34	9	26
52. Naval Biodynamics Lab, New Orleans, LA	16	5	31
53. Naval Air Propulsion Center, Trenton, NJ	201	60	30
54. Naval Civil Engineering Lab, Port Hueneme, CA	213	83	39
55. Navy Clothing and Textile Research Facility, Natick, MA	31	9	29
Navy Labs Total	13,652	5,732	42

SOURCE: SURVEY QUESTION 11.

JM:kg-20
11/8/88

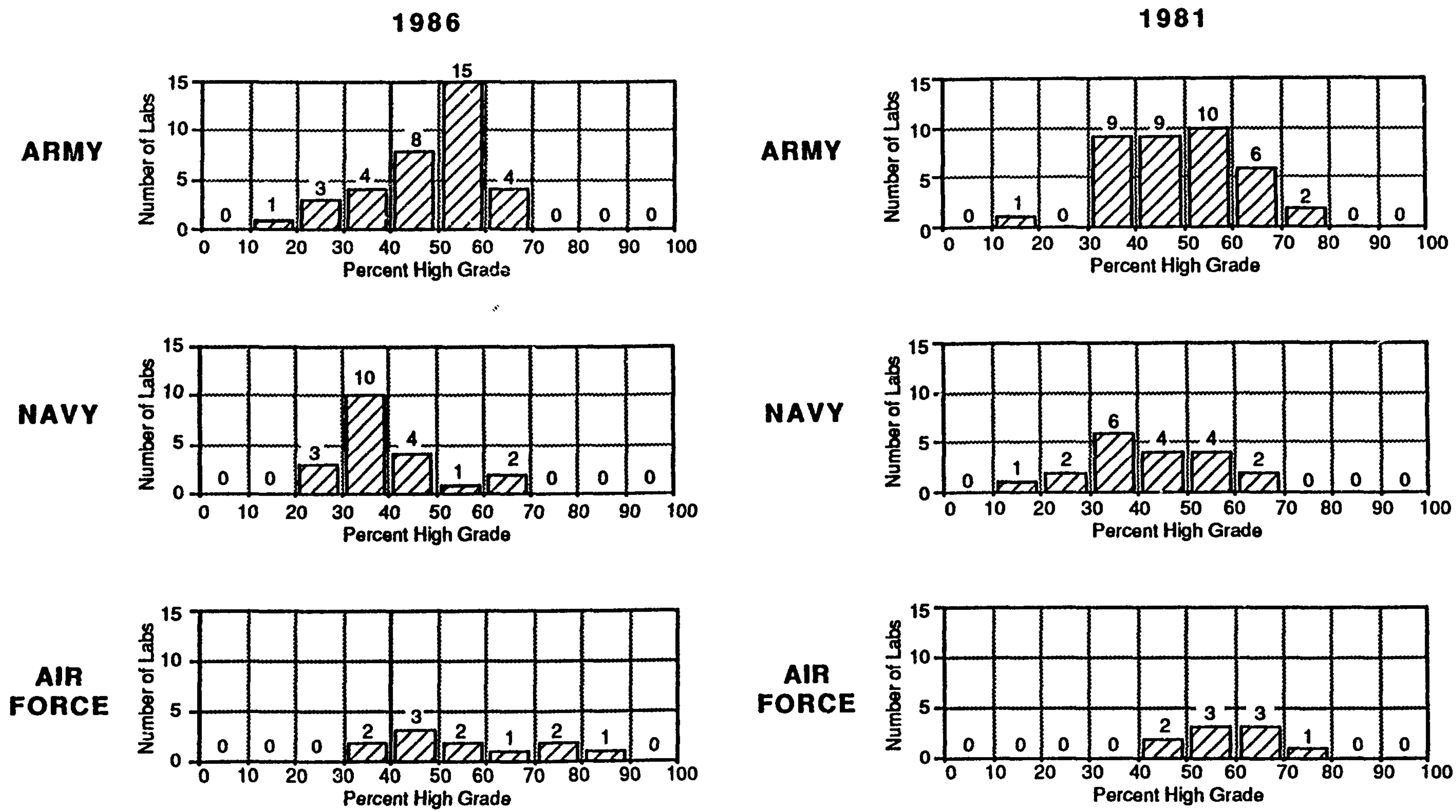
CHART II-14. HIGH-GRADE S&E (GS 13-15), 1986 (Continued)

	AIR FORCE	NUMBER OF CIVILIAN S&E	HIGH-GRADE NUMBER	HIGH-GRADE PERCENT
56.	Air Force Wright Aeronautical Labs, Wright-Patterson AFB, OH	1,289	902	70
57.	AF Armstrong Aerospace Medical Research Lab, Wright-Patterson AFB, OH	89	74	83
58.	AF Armament Test Lab, Eglin AFB, FL	232	95	41
59.	AF Engineering Services Lab, Tyndall AFB, FL	57	20	35
60.	AF Geophysics Lab, Hanscom AFB, MA	255	189	74
61.	AF Human Resource Lab, Brooks AFB, TX	110	50	45
62.	AF Astronautics Lab, Edwards AFB, CA	130	79	61
63.	Rome Air Development Center, Griffiss AFB, NY	570	314	55
64.	AF Weapons Lab, Kirtland AFB, NM	198	117	59
65.	Frank Seiler Research Lab, USAF Academy, CO	3	1	33
66.	USAF School of Aerospace Medicine, Brooks AFB, TX	98	46	47
	Air Force Labs Total	3,031	1,887	62
	All Labs Total	24,984	11,511	46

SOURCE: SURVEY QUESTION 11.

JM:kg-21
11/8/88

CHART II-15. HIGH-GRADE (GS 13-15) S&E AS PERCENTAGE OF LAB S&E POPULATION[a]



[a] Sources: Survey Question 11 for 1986 and Ref. 1 for 1981. All labs included for 1986; six labs with less than 15 civilian S&E are excluded for 1981.

CHART II-16. NUMBER OF PART-TIME AND TEMPORARY S&E, 1986[a]

	PART-TIME PERMANENT	TEMPORARY			TOTAL
		CO-OP	AIDE	OTHER[b]	
SCIENTISTS	71	92	57	205	425
ENGINEERS	64	483	55	90	692
OTHER	114	32	57	371	574
TOTAL	249	607	169	666	1,691

[a] SOURCE: SURVEY QUESTION 1.

[b] FULL-TIME OR PART-TIME.

JM:kg-22
11/9/88

CHART II-17. NUMBER OF PART-TIME AND TEMPORARY PERSONNEL BY SERVICE, 1986[a]

ELEMENT	ARMY	NAVY	AF	TOTAL
NUMBER OF PARTICIPATING LABS	33	17	10	60
PART-TIME PERMANENT	62	169	18	249
CO-OP	207	304	96	607
AIDES	63	86	20	169
OTHER TEMPORARY[b]	236	334	96	666
TOTAL	568	893	230	1,691

[a] SOURCE: SURVEY QUESTION I.

[b] FULL-TIME OR PART-TIME.

JM:kg-23
11/9/88

CHART II-18. NUMBER OF RETIRED ANNUITANTS REHIRED AS TEMPORARY S&E, 1986[a]

LABS	SCIENTISTS	ENGINEERS
ARMY	8	19
NAVY	22	28
AIR FORCE	2	14
ALL LABS	32	61
PERCENTAGE OF ALL TEMPORARIES[b]	9%	10%

[a] SOURCE: SURVEY QUESTION 2.

[b] OF 354 SCIENTISTS AND 628 ENGINEERS IN CHART II-16.

JM:kg-24
11/9/88

CHART II-19. NUMBER OF CONTRACT SCIENTISTS AND ENGINEERS ON BASE DURING 1986

	ARMY	NAVY	AIR FORCE	TOTAL
SCIENTISTS	456	908	328	1,692
NUMBER OF LABS	18	9	7	34
ENGINEERS	890	1,723	144	2,757
NUMBER OF LABS	17	6	7	30

SOURCE: SURVEY QUESTION 3.

JM:kg-26
11/9/88

CHART II-20. CONTRACT S&E ON BASE IN 1986[a]

ARMY	NUMBER OF LAB CIVILIAN S&E	NUMBER OF CONTRACT S&E ON BASE SCIENTISTS	ENGINEERS	RATIO OF CONTRACT S&E ON BASE TO LAB S&E
1. Armament RDE Center	682	0	0	0
2. Atmospheric Sciences Lab	133	47	10	0.43
3. Avionics R&D Activity	157	6	0	0.04
4. Ballistic Research Lab	447	20	5	0.06
5. Chemical RDE Center	650	0	0	0
6. Communications-Electronics RDE Center	313	0	5	0.02
7. Electronics Technology & Devices Lab	186	1	30	0.17
8. Electronics Warfare/Reconnaissance, Surveillance, and Target Acquisition Center	192	0	14	0.07
9. Harry Diamond Labs	421	0	159	0.38
10. Human Engineering Lab	109	2	6	0.07
11. Materials Technology Lab	256	1	3	0.02
12. Missile Command	739	7	395	0.54

[a] SOURCE: SURVEY QUESTION 3. ALL S&E ARE FULL-TIME EQUIVALENTS.

JM:kg-7
5/30/89

CHART II-20. CONTRACT S&E ON BASE IN 1986 (Continued)

ARMY	NUMBER OF LAB S&E	NUMBER OF CONTRACT S&E ON BASE SCIENTISTS	NUMBER OF CONTRACT S&E ON BASE ENGINEERS	RATIO OF CONTRACT S&E ON BASE TO LAB S&E
13. Belvoir RDE Center	427	0	0	0
14. Natick RDE Center	383	7	3	0.03
15. Night Vision & Electro-Optics Center	270	6	9	0.06
16. Aviation Research & Technology Activity	275	0	0	0
17. Signals Warfare Center	77	3	72	0.97
18. Tank-Automotive RDE Center	370	0	0	0
19. Army Research Institute	219	48	0	0.22
20. Cold Regions R&E Lab	120	0	0	0
21. Construction Engineering Research Lab	155	110	125	0.87
22. Engineer Topographic Labs	186	7	1	0.04
23. Engineer Waterways Experiment Station	684	0	0	0
24. Aeromedical Research Lab	20	0	0	0

[a] SOURCE: SURVEY QUESTION 3. ALL S&E ARE FULL-TIME EQUIVALENTS.

JM:kg-8
5/30/89

CHART II-20. CONTRACT S&E ON BASE IN 1986 (Continued)

ARMY	NUMBER OF LAB CIVILIAN S&E	NUMBER OF CONTRACT S&E ON BASE: SCIENTISTS	NUMBER OF CONTRACT S&E ON BASE: ENGINEERS	RATIO OF CONTRACT S&E ON BASE TO LAB S&E
25. Institute for Dental Research	2	0	0	0
26. .. .iute of Surgical Research	13	1	0	0.08
27. Letterman Army Institute of Research	32	0	0	0
28. Biomedical R&D Lab	32	0	0	0
29. Medical Research Institute of Chemical Defense	46	0	0	0
30. Medical Research Institute of Infectious Diseases	62	11	0	0.18
31. Research Institute of Environmental Medicine	47	2	0	0.04
32. Walter Reed Army Institute of Research	139	161	4	1.19
33. Aviation Engineering Flight Activity	29	0	0	0
34. Vulnerability Assessment Lab	115	16	44	0.52
35. Communications/Automated Data Processing Center	313	0	5	0.02
Army Labs Total	8,301	456	890	0.16

[a] SOURCE: SURVEY QUESTION 3. ALL S&E ARE FULL-TIME EQUIVALENTS.

JM:kg-9
5/30/89

CHART II-20. CONTRACT S&E ON BASE IN 1986 (Continued)

NAVY	NUMBER OF LAB S&E	NUMBER OF CONTRACT S&E ON BASE: SCIENTISTS	NUMBER OF CONTRACT S&E ON BASE: ENGINEERS	RATIO OF CONTRACT S&E ON BASE TO LAB S&E
36. Naval Research Lab	1,461	339	392	0.50
37. Naval Ocean Research & Development Activity Bay	167	24	0	0.14
38. Naval Environmental Prediction Research Facility	26	0	0	0
39. David W. Taylor Naval Ship R&D Center	1,365	4	8	0.01
40. Naval Air Development Center	1,523	84	442	0.35
41. Naval Coastal Systems Center	577	0	690	1.20
42. Naval Ocean Systems Center	1,549	0	0	0
43. Navy Personnel Research & Development Center	175	1	0	0.01
44. Naval Surface Weapons Center	2,430	2	0	0
45. Naval Underwater Systems Center	1,924	124	183	0.16
46. Naval Weapons Center	1,818	328	0	0.18
47. Naval Medical Research Institute	75	0	0	0
48. Naval Submarine Medical Research Lab	33	0	0	0

[a] SOURCE: SURVEY QUESTION 3. ALL S&E ARE FULL-TIME EQUIVALENTS.

CHART II-20. CONTRACT S&E ON BASE IN 1986 (Continued)

NAVY	NUMBER OF LAB S&E	NUMBER OF CONTRACT S&E ON BASE SCIENTISTS	NUMBER OF CONTRACT S&E ON BASE ENGINEERS	RATIO OF CONTRACT S&E ON BASE TO LAB S&E
49. Naval Health Research Center	27	0	0	0
50. Naval Dental Research Institute	7	0	0	0
51. Naval Aerospace Medical Research Lab	34	0	0	0
52. Naval Biodynamics Lab	16	2	0	0.13
53. Naval Air Propulsion Center	201	0	0	0
54. Naval Civil Engineering Lab	213	0	8	0.04
55. Naval Clothing and Textile Research Facility	31	0	0	0
Navy Labs Total	13,652	908	1,723	0.19

[a] SOURCE: SURVEY QUESTION 3. ALL S&E ARE FULL-TIME EQUIVALENTS.

JM:kg-11
5/30/89

CHART II-20. CONTRACT S&E ON BASE IN 1986 (Continued)

AIR FORCE	NUMBER OF LAB S&E	NUMBER OF CONTRACT S&E ON BASE SCIENTISTS	NUMBER OF CONTRACT S&E ON BASE ENGINEERS	RATIO OF CONTRACT S&E ON BASE TO LAB S&E
56. Air Force Wright Aeronautical Labs	1,289	0	0	0
57. AF Armstrong Aerospace Medical Research Lab	89	0	0	0
58. AF Armament Test Lab	232	6	11	0.07
59. AF Engineering Services Lab	57	7	9	0.28
60. AF Geophysics Lab	255	48	16	0.25
61. AF Human Resource Lab	110	196	4	1.82
62. AF Astronautics Lab	130	5	9	0.11
63. Rome Air Development Center	570	43	75	0.21
64. AF Weapons Lab	198	0	0	0
65. Frank Seiler Research Lab	3	0	0	0
66. USAF School of Aerospace Medicine	198	23	20	0.22
Air Force Labs Total	3,031	328	144	0.16
All Labs Total	24,984	1,692	2,757	0.18

[a] SOURCE: SURVEY QUESTION 3. ALL S&E ARE FULL-TIME EQUIVALENTS.

CHART II-21. S&E POPULATIONS

LEVEL OF AGGREGATION		1981	1986
NATIONAL	NSF[a]	3.3 MILLION	4.6 MILLION
	BLS[b]	3.1 MILLION	3.2 MILLION
DoD[c]	CIVILIAN	78,000	98,100
	MILITARY	26,800	28,700
	TOTAL	104,800	126,800
DoD LABS[d]	CIVILIAN	21,800	25,000
	MILITARY	1,900	1,700
	TOTAL	23,700	26,700

a NATIONAL SCIENCE FOUNDATION DATA (REFS. 4 AND 5).
b BUREAU OF LABOR STATISTICS DATA (REFS. 6 AND 7); DIFFERENCES BETWEEN NSF'S S&E POPULATIONS AND BLS'S S&E POPULATIONS ARE DISCUSSED IN A NATIONAL ACADEMY OF SCIENCES REPORT (REF. 8) THAT WAS SPONSORED BY THE NSF.
c FROM DMDC AND EARLIER SURVEY (REF. 1); ALL POPULATIONS ROUNDED TO NEAREST HUNDRED.
d FROM EARLIER SURVEY AND 1986 SURVEY QUESTION 11; ALL POPULATIONS ROUNDED TO NEAREST HUNDRED.

JM:kg-7
11/8/88

CHART II-22. DoD LAB AND NATIONAL DISTRIBUTIONS OF CIVILIAN S&E BY DISCIPLINE, IN PERCENTAGES

GROUP	DISCIPLINE	DoD LABS[a]		NATIONAL		
		1981	1986	1981[b]	1986[c]	1986[d]
SCIENTISTS	PHYSICAL	57	48	15	13	24
	MATHEMATICAL	23	22	8	6	48
	COMPUTER	3	12	23	26	
	SOCIAL & PSYCHOLOGISTS	7	7	22	31	15
	LIFE	6	6	25	19	5
	ENVIRONMENTAL	3	5	6	5	8
	TOTAL	99	100	99	100	100
ENGINEERS	ELECTRICAL/ELECTRONICS	44	43	18	24	31
	MECHANICAL	20	22	17	20	16
	AERONAUTICAL	10	9	3	4	5
	CIVIL	4	4	14	14	13
	CHEMICAL	3	3	5	6	3
	OTHER	19	19	43	31	30
	TOTAL	100	100	100	99	98
S&E WORKFORCE	SCIENTISTS	38	36	52	47	43
	ENGINEERS	62	64	48	53	57
	TOTAL	100	100	100	100	100

[a] SOURCES: REF. 1 FOR 1981 AND SURVEY QUESTION 11 FOR 1986.
[b] SOURCE: REF. 1.
[c] SOURCE: NATIONAL SCIENCE FOUNDATION (REF. 4).
[d] SOURCE: BUREAU OF LABOR STATISTICS DATA IN A NATIONAL RESEARCH COUNCIL REPORT (REF. 8).

JM:kg-1
10/23/89

CHART II-23. EDUCATION LEVELS OF CIVILIAN S&E, DoD LABS AND NATIONAL, 1986

	TOTAL S&E POPULATION	HIGHEST DEGREE, PERCENT OF TOTAL S&E POPULATION			
		DOCTOR'S	MASTER'S	BACHELOR'S	OTHER
DoD LABS[a]	24,984	13.5	25.5	59.0	2.0
NATIONAL, NSF[b]	4,626,500	13.3	23.6	57.0	6.1
NATIONAL, BLS[c]	3,226,000	9.4	23.0	65.3	2.3

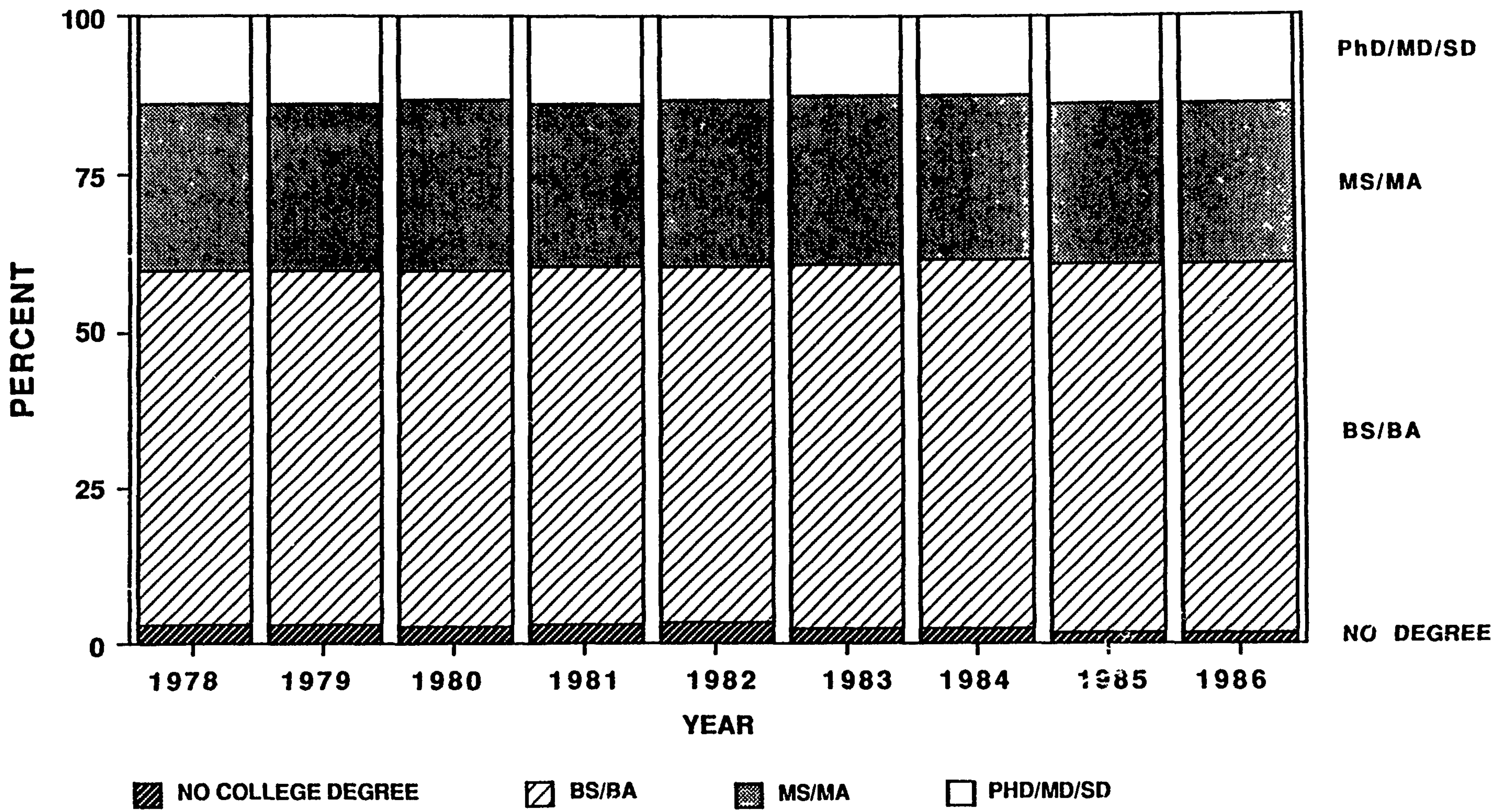
[a] SOURCE: SURVEY QUESTION 11.

[b] NATIONAL SCIENCE FOUNDATION (REF. 4).

[c] POPULATION IS FROM THE BUREAU OF LABOR STATISTICS (REF. 7); DISTRIBUTION BY LEVEL OF HIGHEST DEGREE IS A UNIVERSITY OF MICHIGAN ESTIMATE FOR 1984 (REF. 8), A YEAR IN WHICH THE BLS S&E POPULATION WAS 3,071,000 (REF. 9).

JM:kg-14
11/8/88

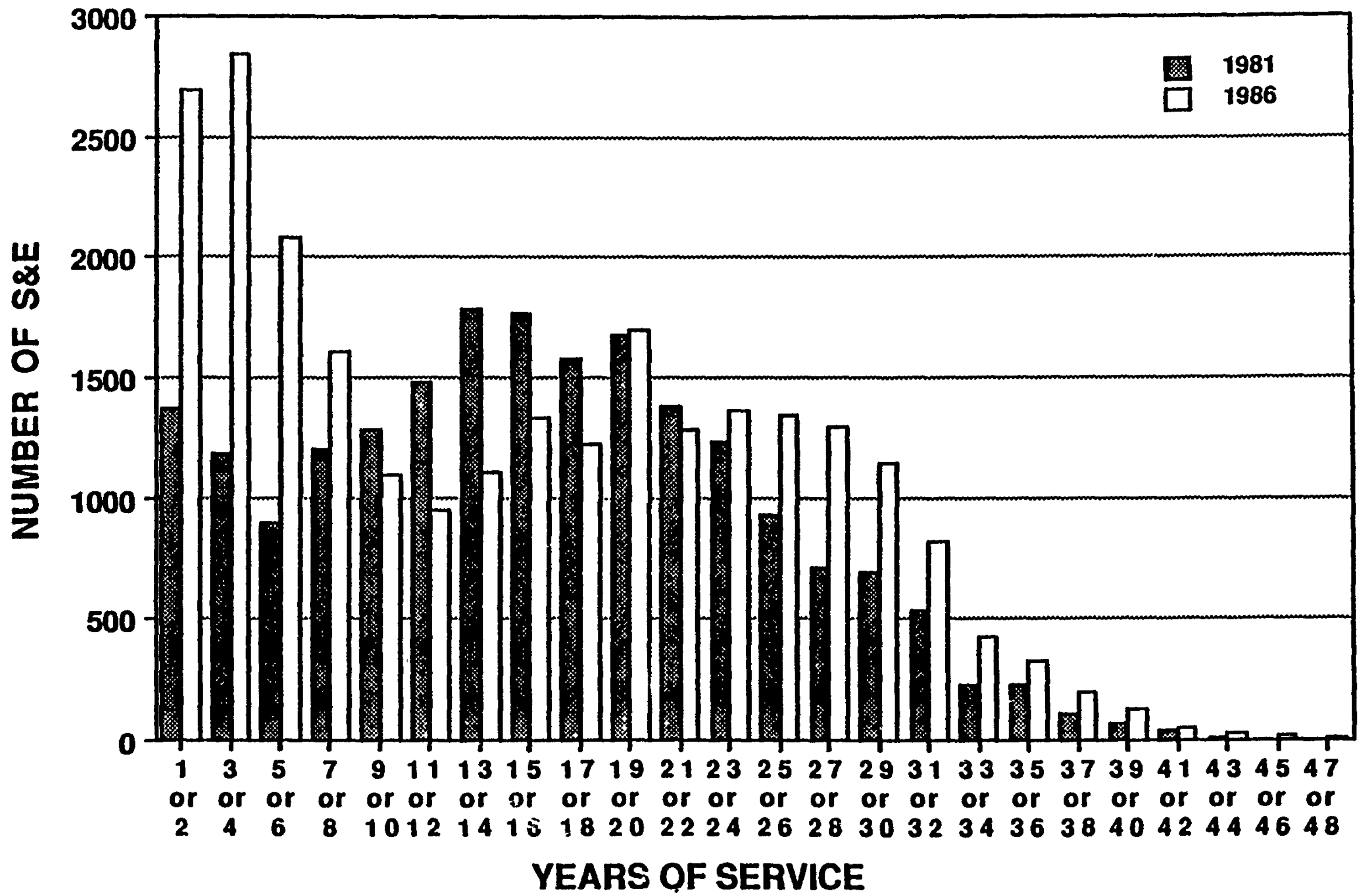
CHART II-24. EDUCATION LEVEL OF DoD LAB CIVILIAN S&E



SOURCE: DMDC.

JM:ad-88-0854
11/11/88

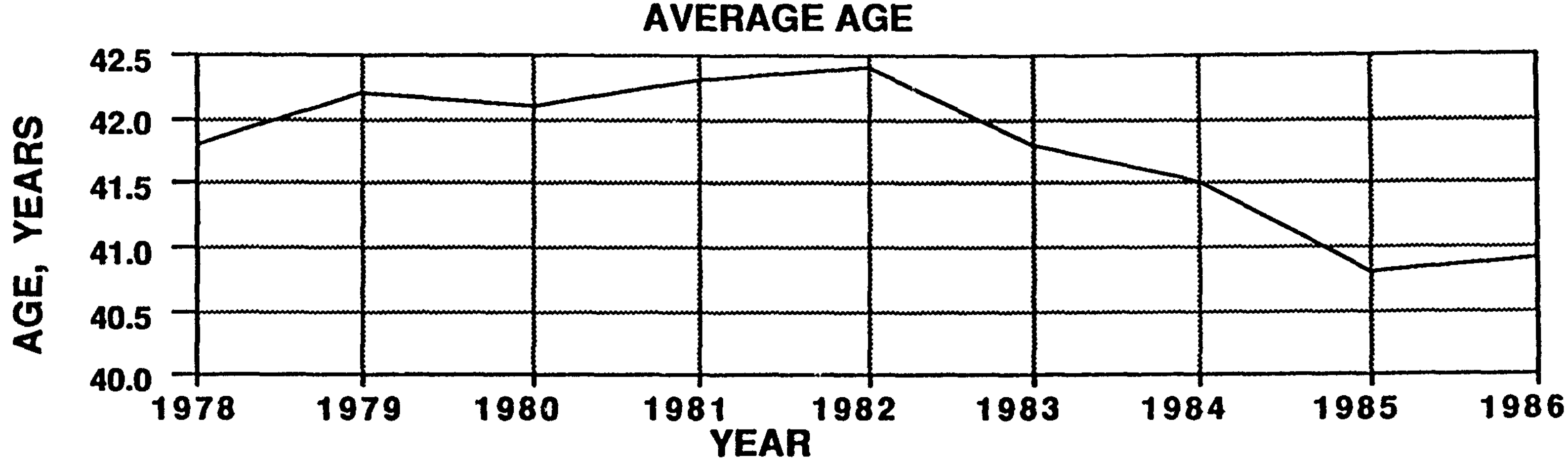
CHART II-25. LENGTH OF GOVERNMENT SERVICE OF CIVILIAN S&E, 1981 AND 1986

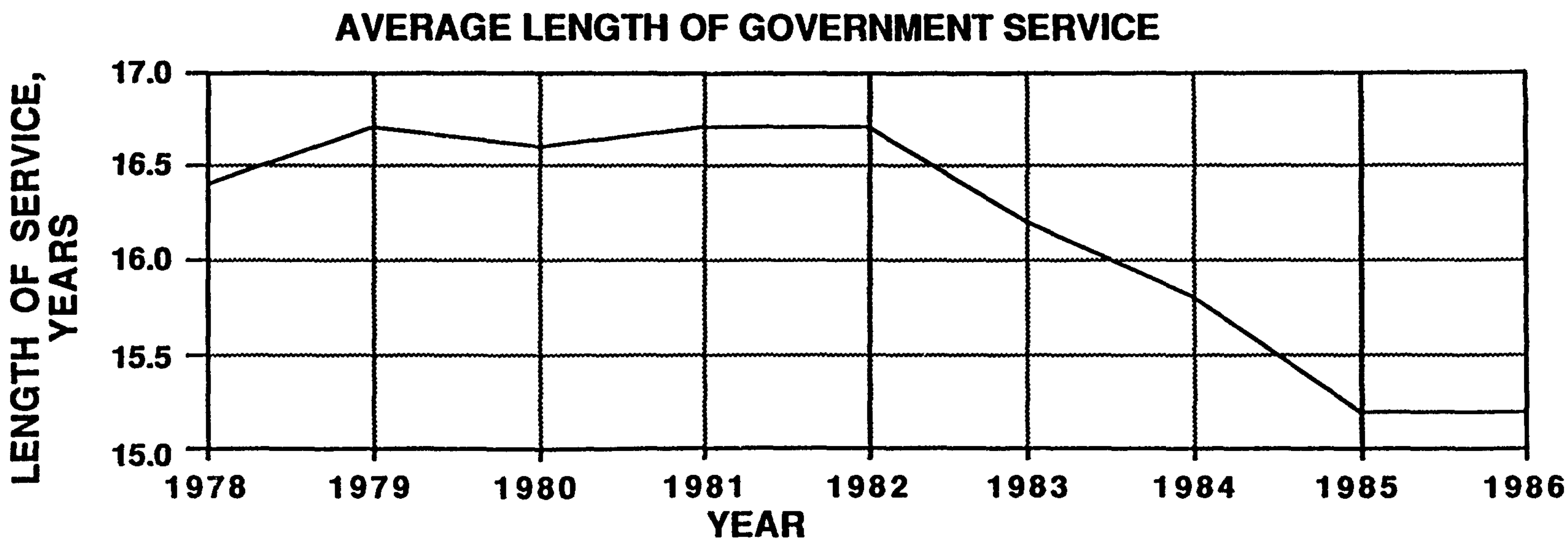


SOURCE: DMDC.

JM:ad-87-3801
11/11/88

CHART II-26. AVERAGE AGE AND AVERAGE LENGTH OF GOVERNMENT SERVICE OF CIVILIAN S&E, ALL LABS

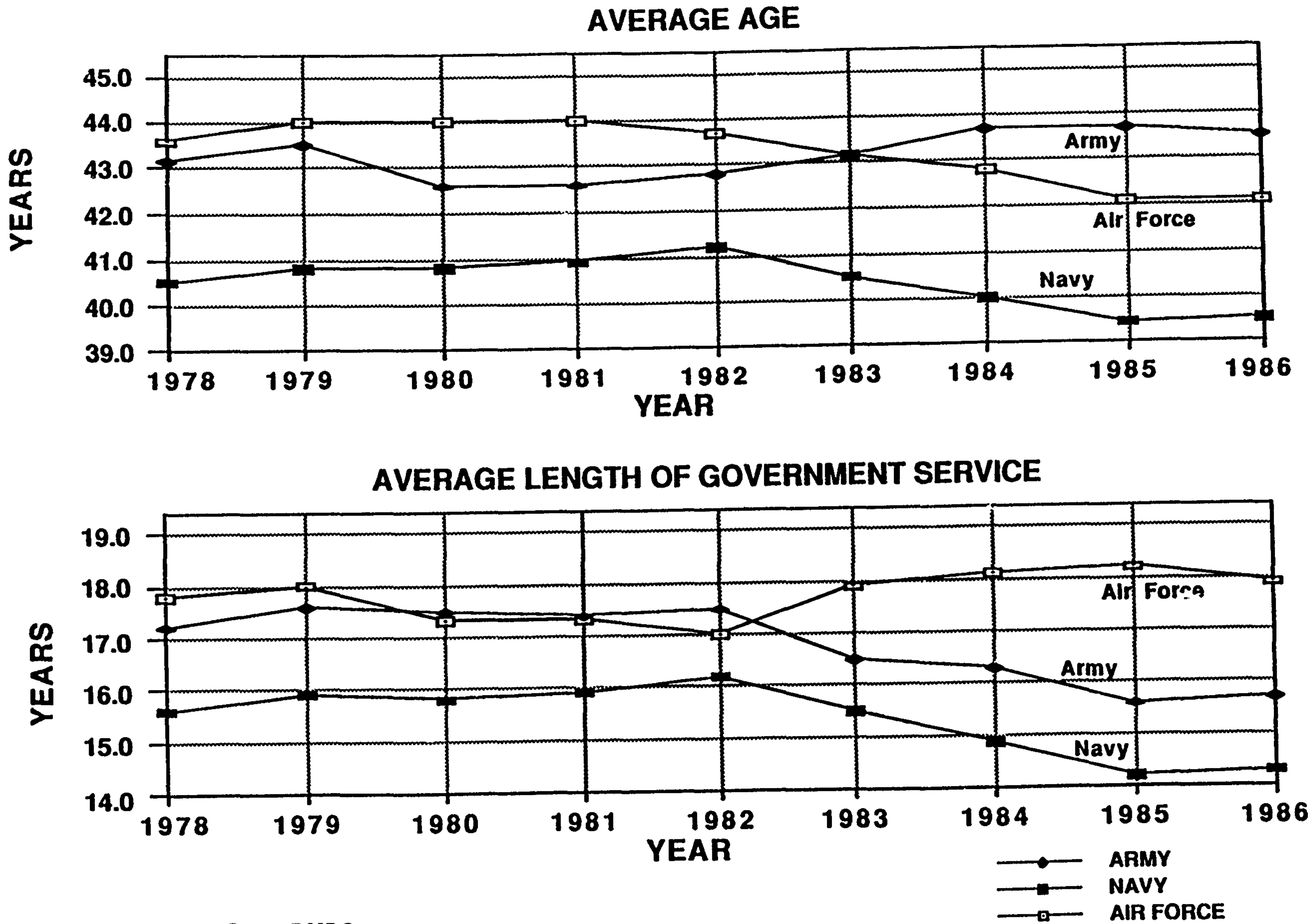




SOURCE: DMDC.

JM:ad-87-3808
11/11/88

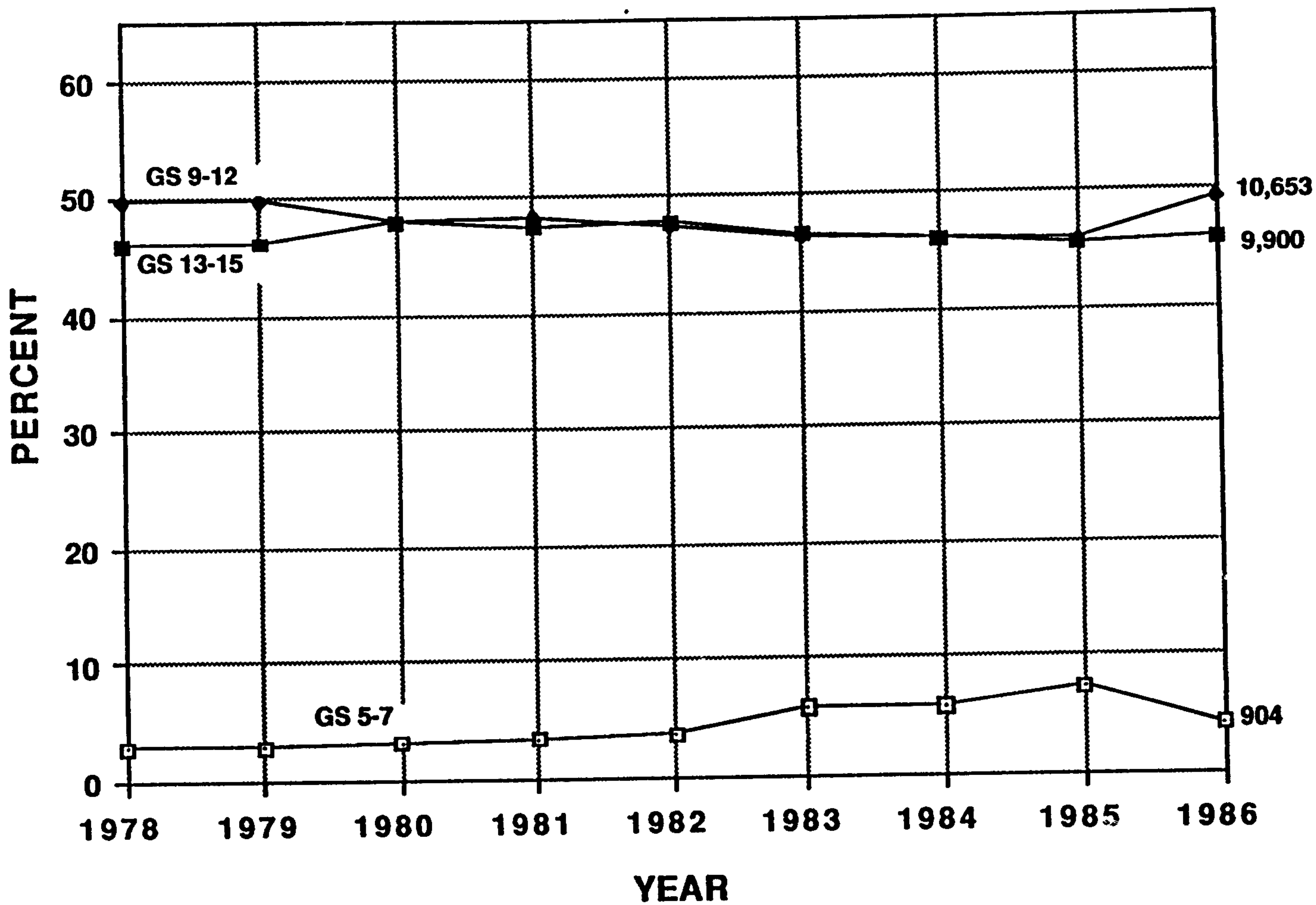
CHART II-27. AVERAGE AGE AND AVERAGE LENGTH OF GOVERNMENT SERVICE OF CIVILIAN S&E, BY SERVICE



JM:ad-87-3809
11/11/88

SOURCE: DMDC.

CHART II-28. CIVILIAN S&E GRADE DISTRIBUTION TREND

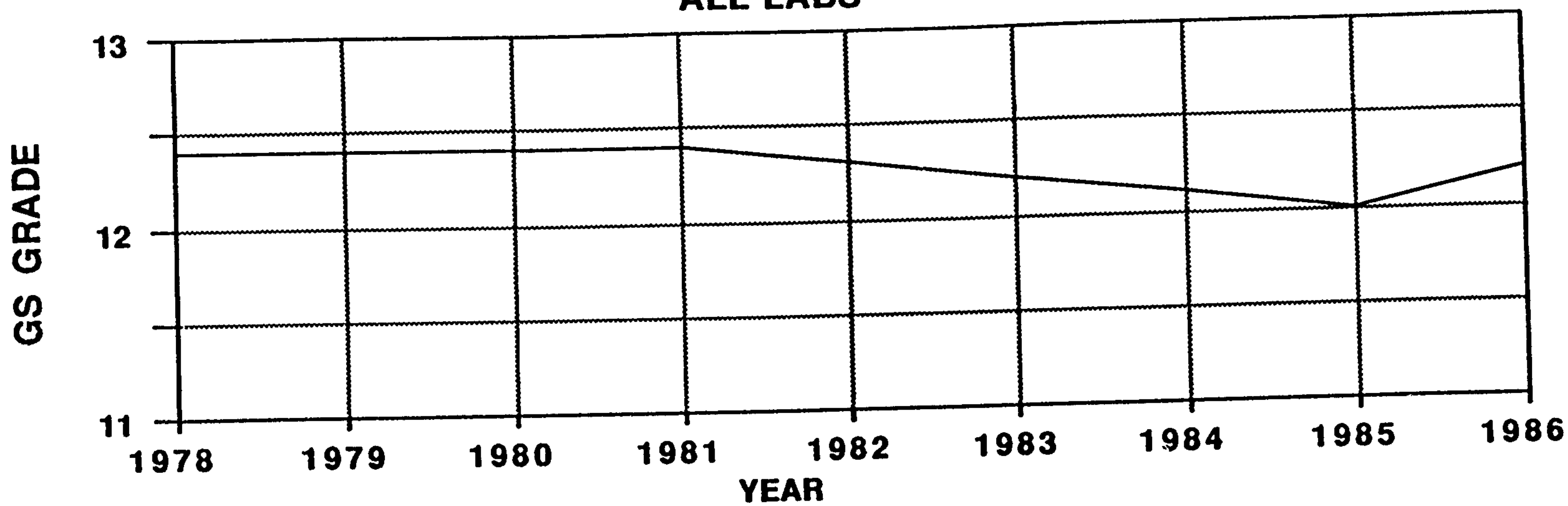


SOURCE: DMDC. GS 9-12 AND GS 13-15 GRADE EQUIVALENTS AT NAVY DEMONSTRATION LABS ARE NOT INCLUDED.

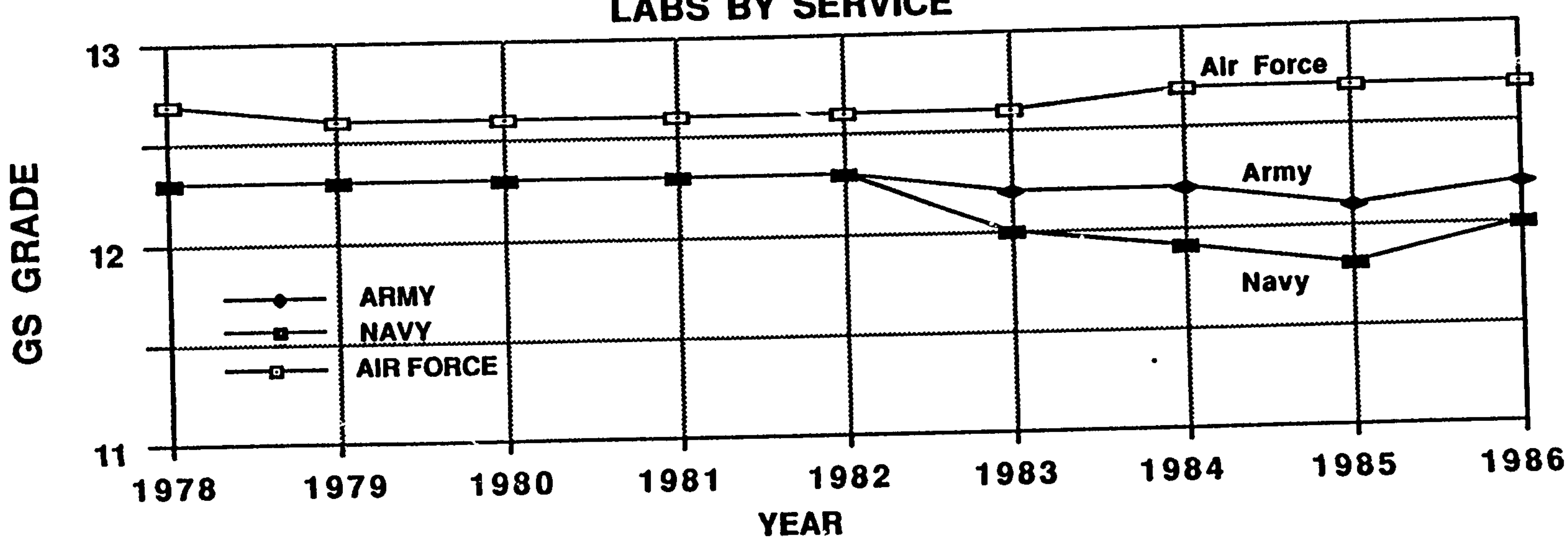
JM:ad-88-7190
11/11/88

CHART II-29. AVERAGE GRADE OF CIVILIAN S&E

ALL LABS



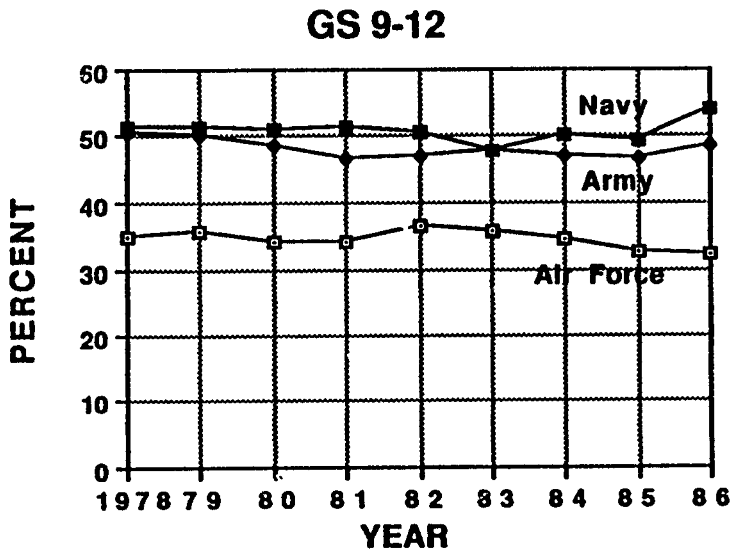
LABS BY SERVICE

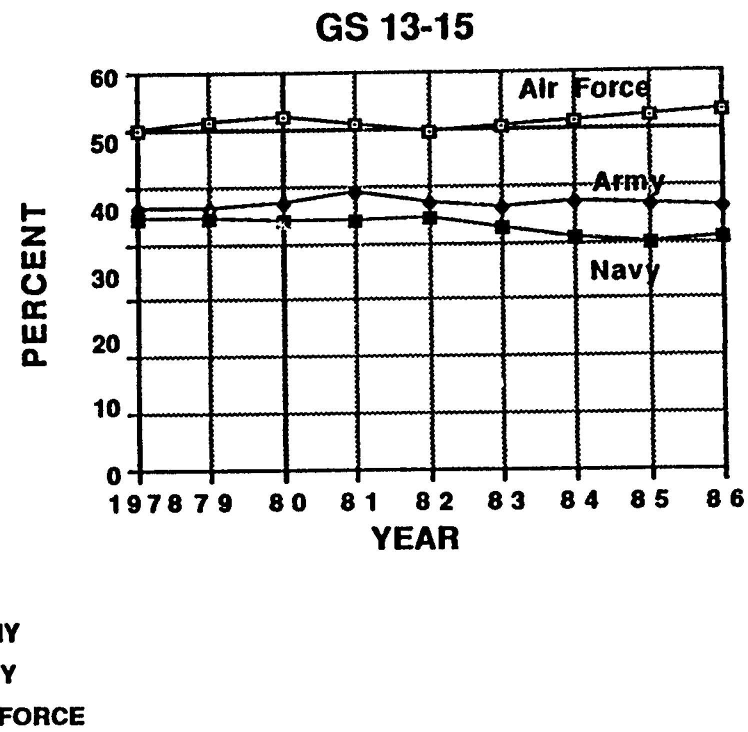


SOURCE: DMDC. ONLY GS/GM ARE COUNTED; NAVY DEMONSTRATION LABS PERSONNEL NOT INCLUDED; SES NOT INCLUDED.

JM:ad-87-3810
11/11/88

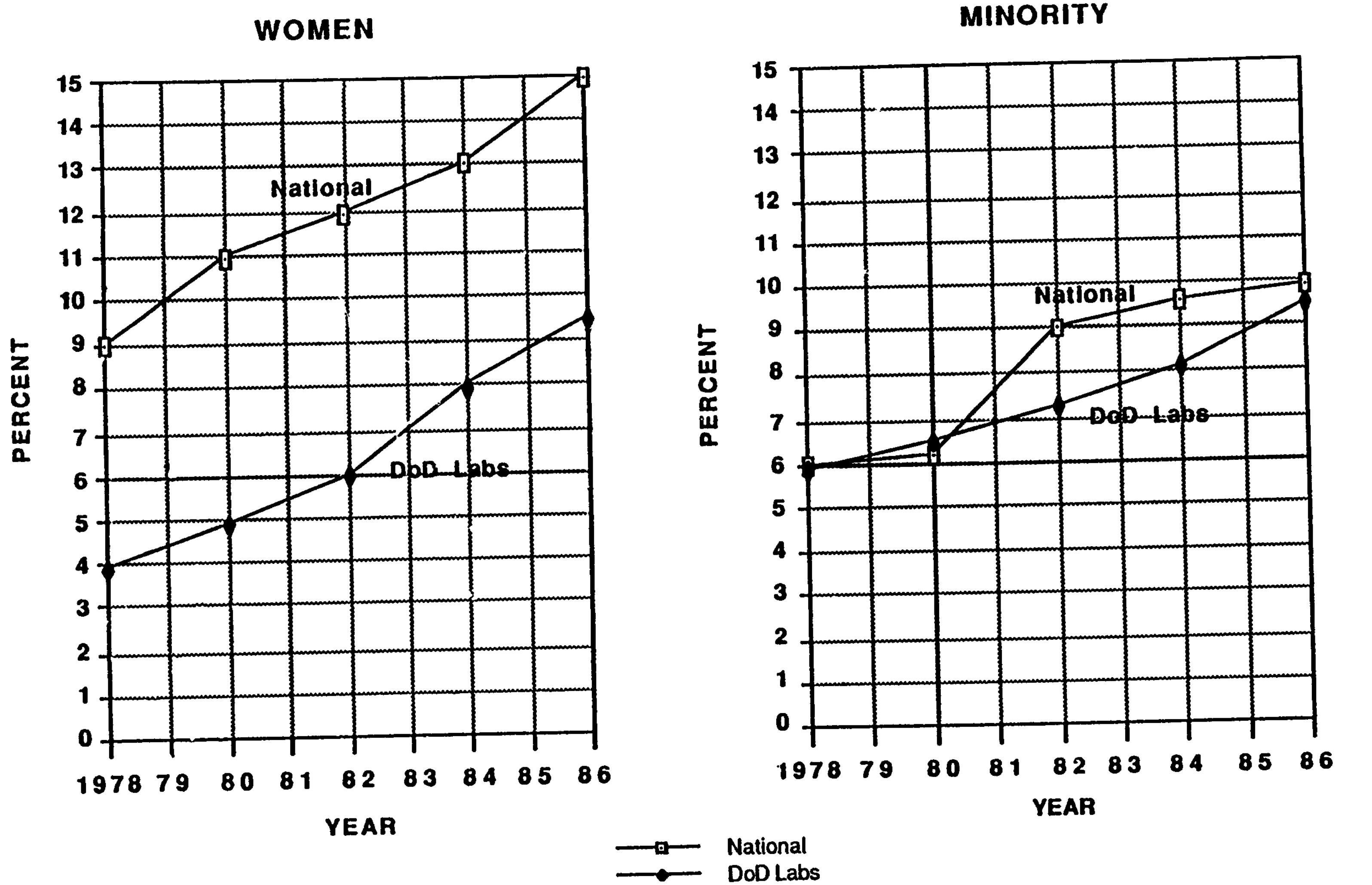
CHART II-30. CIVILIAN S&E GRADE DISTRIBUTION BY SERVICE





SOURCE: DMDC.

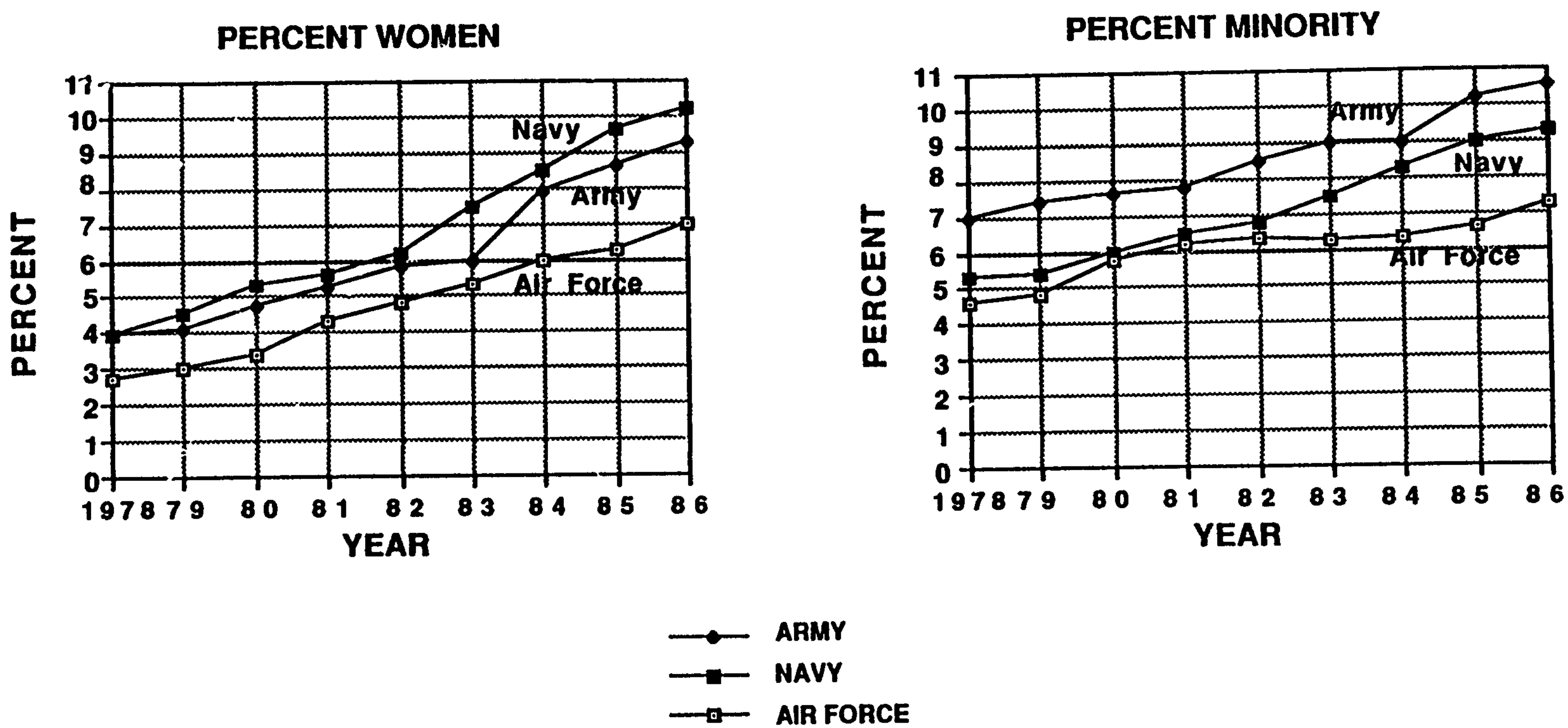
CHART II-31. CIVILIAN S&E WOMEN AND MINORITY EMPLOYMENT[a]



[a] MINORITY INCLUDES BLACKS, ASIANS, NATIVE AMERICANS, AND HISPANICS OF ALL RACIAL GROUPS; DoD LAB S&E DATA FROM DMDC; NATIONAL S&E DATA FROM NSF (Ref. 4).

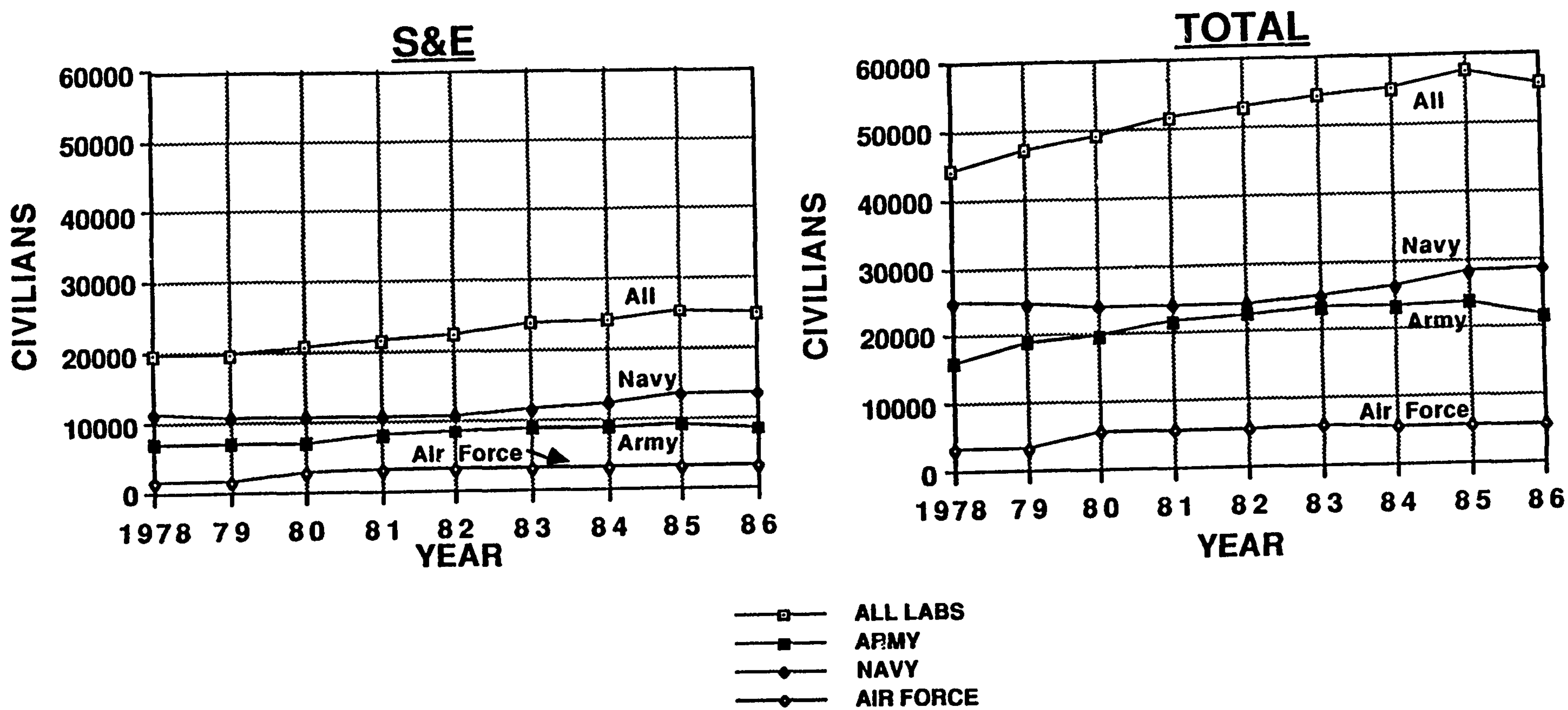
JM:ad-1

CHART II-32. CIVILIAN S&E WOMEN AND MINORITY EMPLOYMENT, BY SERVICE



SOURCE: DMDC.

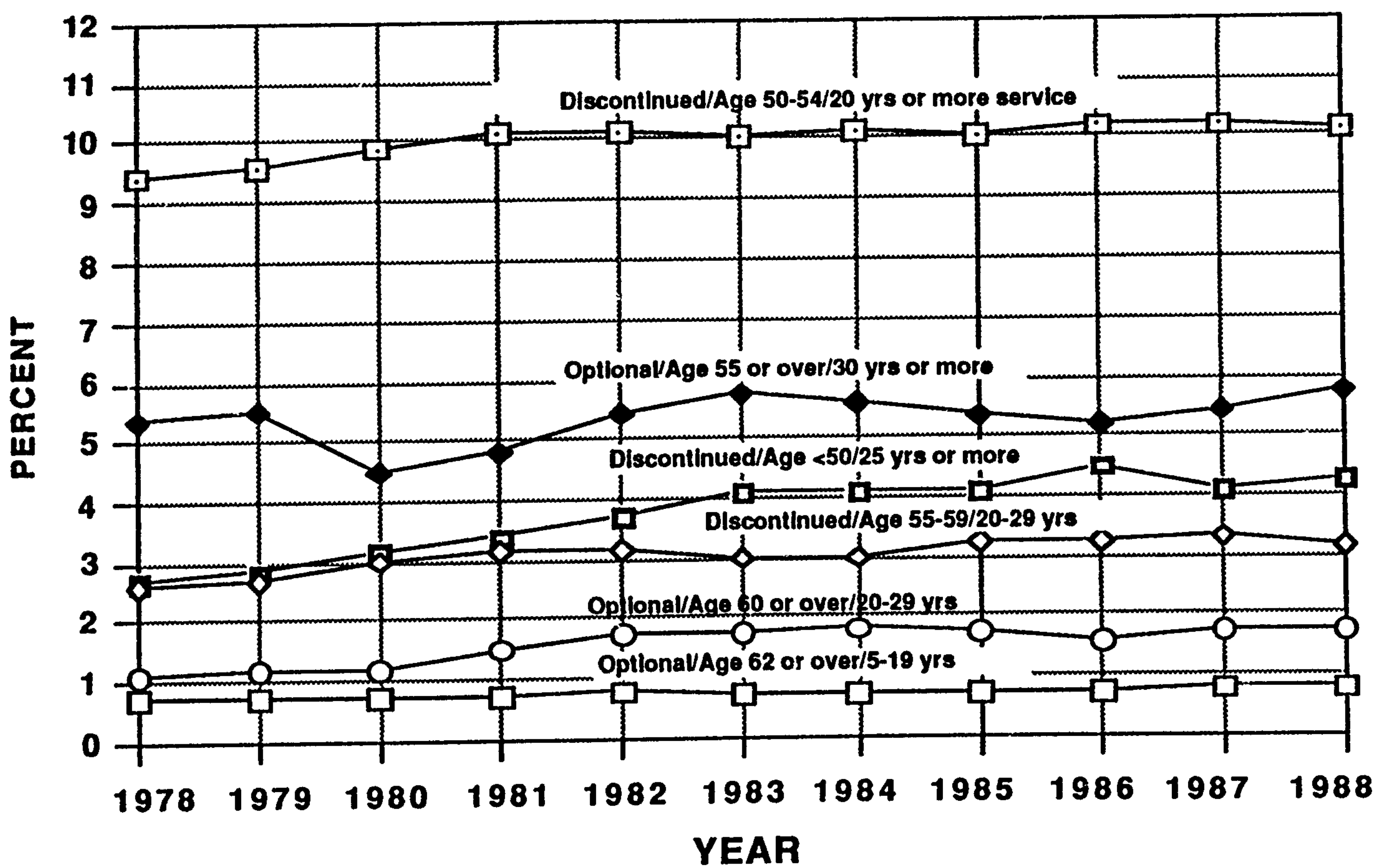
CHART II-33. CIVILIAN EMPLOYMENT TREND IN DoD LABS



SOURCE: DMDC.

JM:ad-87-3063
11/11/88

CHART II-34. CIVILIAN S&E RETIREMENT ELIGIBILITY



NOTE

THE SIX CATEGORIES OF RETIREMENT ELIGIBILITY ARE MUTUALLY EXCLUSIVE.

NORMAL RETIREMENT IS OPTIONAL FOR MOST S&E WITH ANY OF THE THREE COMBINATIONS OF AGE AND LENGTH OF SERVICE INDICATED.

JOB DISCONTINUANCE WOULD MAKE S&E ELIGIBLE FOR "EARLY OUT" RETIREMENT IF THEIR AGE AND LENGTH OF SERVICE PUT THEM IN THE OTHER THREE CATEGORIES.

SOURCE: DMDC.

CHART II-35. PERCENTAGE OF CIVILIAN S&E ELIGIBLE FOR NORMAL RETIREMENT

CRITERIA FOR RETIREMENT ELIGIBILITY		YEAR										
AGE	YEARS OF SERVICE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987[a]	1988[a]
55 OR OVER	30 OR MORE	5.2	5.5	4.4	4.8	5.4	5.7	5.6	5.2	5.1	5.4	5.7
60 OR OVER	20-29	1.1	1.2	1.2	1.6	1.7	1.7	1.8	1.7	1.6	1.6	1.7
62 OR OVER	5-19	0.7	0.7	0.7	0.7	0.8	0.7	0.7	0.7	0.7	0.8	0.8
TOTAL		7.0	7.4	6.3	7.1[b]	7.9	8.1	8.1	7.6	7.4	7.9	8.2

[a] IN ADDITION TO PROVIDING RETIREMENT-ELIGIBILITY DATA FOR THE STUDY'S LARGE INITIAL DATA COLLECTION, DMDC LATER MADE SPECIAL FILE SEARCHES TO PROVIDE 1987-1988 DATA. IN 1987, THE TOTAL NUMBER OF RETIREMENT-ELIGIBLES IS 2,118, WHICH IS 7.9 PERCENT OF THE 1987 S&E POPULATION OF 26,951. IN 1988, THE TOTAL NUMBER OF RETIREMENT-ELIGIBLES IS 2,213, WHICH IS 8.2 PERCENT OF THE 1988 S&E POPULATION OF 26,870.

[b] 7.1 PERCENT OF 21,767 S&E (CHART II-8) EQUATES TO 1,545 RETIREMENT-ELIGIBLES.

JM:kg-2
10/23/89

III. S&E HELP WANTED

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Needs for lab S&E reflect two kinds of shortages: (1) vacancies that exist when authorized positions are unfilled, and (2) S&E whom lab directors perceive they require above current authorization limits in order to perform lab work (thus, "needs" equals "vacancies" plus "additional S&E" that are not authorized). Quite obviously, work that would be performed by the additional in-house S&E is being performed currently as part of the contracted-out RDT&E effort discussed in the previous chapter.

A. VACANCIES

Chart III-1 shows vacancies at the end of 1986 for occupations that experienced S&E scarcity in the 1981 DoD lab study. The labs say that electrical engineers, biomedical engineers, and chemists are the highest-vacancy occupations percentagewise. On a numbers basis, the labs indicate EE is the field with the most vacancies.

Charts III-2, -3, and -4 provide data on labs whose vacancy rates are ten percent or more.

B. NEEDS

Chart III-5 indicates S&E needs that the labs perceive in occupations that exhibited serious shortages in 1981. Of the total 13,324 S&E needed in Chart III-5, 94 percent are for personnel to do work for which positions are not authorized; Chart III-1 shows that 810 vacancies account for only six percent of S&E needs.

The labs identified needs--without breaking them into "vacancy" and "beyond-authorization" categories--for another 723 S&E (in addition to the 13,324 in Chart III-5) in occupations that were not listed in the survey questionnaire as suffering

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C. SKILL SHORTAGES

Charts III-7 through -10 indicate the degree of seriousness that labs rate personnel scarcity in 19 multidisciplinary skills. The following skills were identified as serious or very serious problems with regard to S&E scarcity by at least one third of the labs: artificial intelligence, computer engineering, computer networking, signal processing, and systems engineering. If our consensus criterion is at least 20-percent agreement, the following skills would be added to that list: acoustics, biomechanics, ceramics, control system engineering, digital communications, fiber optics, human factors, robotics, and weapons design.

CHART III-1. 1986 VACANCIES IN OCCUPATIONS THAT WERE NOTABLY SHORT IN 1981

OCCUPATION	VACANCIES (AUTHORIZED BUT UNFILLED S&E POSITIONS)	
	NUMBER	PERCENT OF AUTHORIZATION
ELECTRICAL ENGINEER	38	19.7
BIOMEDICAL ENGINEER	5	12.2
CHEMIST	43	11.3
MATHEMATICIAN	39	9.7
GENERAL ENGINEER	99	9.2
OPERATIONS RESEARCH	25	8.3
COMPUTER SCIENTIST	83	7.9
PHYSICIST	95	6.4
AERONAUTICAL ENGINEER	41	5.0
ELECTRONICS ENGINEER	232	4.8
MECHANICAL ENGINEER	96	4.8
PSYCHOLOGIST	14	2.0
NUCLEAR ENGINEER	0	0.0
TOTALS	810	6.1

SOURCE: SURVEY QUESTION 12.

JM:kg-78
11/14/88

CHART III-2. END-OF-YEAR S&E VACANCIES[a]

	ARMY		NAVY		AIR FORCE		TOTAL	
	1981	1986	1981	1986	1981	1986	1981	1986
PERCENT MILITARY VACANCIES	19	12	15	14	13	12	17	13
PERCENT CIVILIAN VACANCIES	8	6	3	6	4	8	5	6
NUMBER OF LABS WITH 10% OR MORE CIVILIAN VACANCIES								
HARDWARE LABS	8	5	0	5	1	4	9	14
MEDICAL/HUM RES LABS[b]	8	2	2	3	0	1	10	6
NUMBER OF LABS WITH 20% OR MORE CIVILIAN VACANCIES								
HARDWARE LABS	2	0	0	0	0	0	2	0
MEDICAL/HUM RES LABS	2	0	1	1	0	1	3	2

[a] 1981 DATA FROM REF. 1; 1986 DATA FROM SURVEY QUESTION 16.
[b] HUM RES = HUMAN RESOURCES.

JM:kg-79
11/14/88

CHART III-3. CIVILIAN VACANCIES BY REGION

REGION	NUMBER OF LABS		NUMBER OF LABS WITH MORE THAN 10% VACANCIES	
	1981	1986	1981	1986
DC METROPOLITAN AREA	12	11	7	4
NORTHEAST (MA, CT, NH, RI, NY)	10	9	1	4
MIDATLANTIC (NJ, PA, MD, VA)	18	15	6	4
SOUTH (FL, AL, MS, LA)	10	9	2	3
MIDWEST (OH, IL, MI)	7	5	0	1
WEST (TX, NM, CA, CO)	14	17	3	4
TOTAL	71	66	19	20

SOURCE: 1981 DATA FROM REF. 1; 1986 DATA FROM SURVEY QUESTION 16.

JM:kg-80
11/14/88

CHART III-4. LABS WITH 10 PERCENT OR MORE VACANCIES BASED ON AUTHORIZED STRENGTH

NAVAL BIODYNAMICS LAB, NEW ORLEANS, LA	25 PERCENT
AIR FORCE HUMAN RESOURCE LAB, BROOKS AFB, TX	22
NAVY CLOTHING AND TEXTILE RESEARCH FACILITY, NATICK, MA	19
NAVAL MEDICAL RESEARCH INSTITUTE, BETHESDA, MD	16
AIR FORCE ARMAMENT TEST LAB, EGLIN AFB, FL	16
ARMY BIOMEDICAL RESEARCH LAB, FREDERICK, MD	16
NAVAL AIR PROPULSION CENTER, TRENTON, NJ	15
NAVAL SUBMARINE MEDICAL RESEARCH LAB, NEW LONDON, CT	15
NAVAL CIVIL ENGINEERING LAB, PORT HUENEME, CA	15
DAVID TAYLOR NAVAL SHIP R&D CENTER, BETHESDA, MD	14
AIR FORCE WEAPONS LAB, KIRTLAND AFB, NM	14
WALTER REED ARMY INSTITUTE OF RESEARCH, WASHINGTON, DC	13
ARMY RESEARCH, DEVELOPMENT AND ENGINEERING CENTER, WARREN, MI	13
ARMY BELVOIR RDE CENTER, FT. BELVOIR, VA	12
ARMY NATICK RDE CENTER, NATICK, MA	12
AIR FORCE GEOPHYSICS LAB, HANSCOM AFB, MA	11
ARMY ELECTRONICS AND DEVICES LAB, FT. MONMOUTH, NJ	11
ARMY ELECTRONICS WARFARE/REC., SURV., TARGET ACQUIS., FT. MONMOUTH, NJ	10
NAVAL OCEAN R&D ACTIVITY, BAY ST. LOUIS, MS	10
FRANK SEILER RESEARCH LAB, USAF ACADEMY, CO	10

JM:ad-3
11/8/88

SOURCE: SURVEY QUESTION 16.

CHART III-5. 1986 NEEDS IN OCCUPATIONS THAT WERE MOST SCARCE IN 1981

OCCUPATION	NUMBER NEEDED		
	CIVILIAN	MILITARY	TOTAL
ELECTRICAL ENGINEER	180	13	193
BIOMEDICAL ENGINEER	27	14	41
CHEMIST	341	39	380
MATHEMATICIAN	398	4	402
GENERAL ENGINEER	1,035	44	1,079
OPERATIONS RESEARCH	292	10	302
COMPUTER SCIENTIST	1,001	49	1,050
PHYSICIST	1,423	54	1,477
AERONAUTICAL ENGINEER	742	78	820
ELECTRONICS ENGINEER	4,722	160	4,882
MECHANICAL ENGINEER	1,967	29	1,996
PSYCHOLOGIST	676	18	694
NUCLEAR ENGINEER	7	1	8
TOTALS	12,811	513	13,324

SOURCE: SURVEY QUESTION 12. "NEEDS" INCLUDE (1) S&E VACANCIES THAT EXIST BECAUSE AUTHORIZED POSITIONS ARE NOT FILLED AND (2) ADDITIONAL S&E, i.e., ABOVE CURRENT AUTHORIZATION, FOR LAB WORK.

JM:kg-78a

CHART III-6. OTHER OCCUPATIONS IN WHICH MORE S&E ARE REQUIRED, END OF 1986[a]

OCCUPATION	NUMBER NEEDED[b]
NAVAL ARCHITECT	215
ASTRONOMY AND SPACE SCIENTIST	36
MICROBIOLOGIST	94
METALLURGIST	47
INDUSTRIAL ENGINEER	25
MATERIALS SCIENTIST	100
CHEMICAL ENGINEER	73
CIVIL ENGINEER	42

[a] SOURCE: SURVEY QUESTION 12. "NEEDS" INCLUDE (1) S&E VACANCIES THAT EXIST BECAUSE AUTHORIZED POSITIONS ARE NOT FILLED AND (2) ADDITIONAL S&E, I.E., ABOVE CURRENT AUTHORIZATION, FOR LAB WORK.
[b] ABOVE CURRENT AUTHORIZATION.

JM:ad-8
11/8/88

CHART III-7. PERCENTAGE OF LABS FOR WHICH SHORTAGES OF PERSONNEL WITH INDICATED MULTIDISCIPLINARY BACKGROUNDS ARE A VERY SERIOUS PROBLEM

MULTIDISCIPLINARY SKILLS	ARMY	NAVY	AIR FORCE	TOTAL
Acoustics	5.6	44.0	0.0	11.6
Artificial Intelligence	13.3	14.3	20.0	14.8
Biomechar ics	0.0	10.0	0.0	2.6
Ceramics	0.0	22.2	0.0	5.3
Computer Engineering	7.7	21.4	0.0	9.8
Computer Networking	13.6	8.3	0.0	9.1
Control System Engineering	0.0	20.0	0.0	6.5
Digital Communications	0.0	0.0	0.0	0.0
Fiber Optics	4.0	0.0	10.0	4.4
Geophysics	0.0	0.0	0.0	0.0
Human Factors	4.3	0.0	0.0	2.2
Infrared Manufacturing Engineering	0.0	0.0	0.0	0.0
Ocean Engineering	0.0	0.0	0.0	0.0
Physical Chemistry	0.0	0.0	0.0	0.0
Robotics	7.7	0.0	0.0	4.8
Signal Processing	4.5	18.2	20.0	11.1
Systems Engineering	18.2	36.4	0.0	19.0
Telecommunications	0.0	0.0	0.0	0.0
Weapons Design	0.0	0.0	14.3	2.9

SOURCE: SURVEY QUESTION 13.

JM:ad-4
11/8/88

CHART III-8. PERCENTAGE OF LABS FOR WHICH SHORTAGES OF PERSONNEL WITH INDICATED MULTIDISCIPLINARY BACKGROUNDS ARE A SERIOUS PROBLEM

MULTIDISCIPLINARY SKILLS	ARMY	NAVY	AIR FORCE	TOTAL
Acoustics	5.6	33.3	0.0	9.3
Artificial Intelligence	16.7	64.3	50.0	35.2
Biomechanics	14.3	20.0	28.6	18.4
Ceramics	9.1	22.2	46.9	18.4
Computer Engineering	19.2	71.4	27.3	35.3
Computer Networking	9.1	41.7	40.0	25.0
Control System Engineering	5.3	50.0	11.1	22.6
Digital Communications	17.4	40.0	22.2	23.8
Fiber Optics	8.0	40.0	20.0	17.8
Geophysics	0.0	0.0	22.2	2.6
Human Factors	21.7	23.1	30.0	23.9
Infrared Manufacturing Engineering	0.0	0.0	11.1	2.7
Ocean Engineering	0.0	22.2	0.0	5.7
Physical Chemistry	4.8	0.0	10.0	5.0
Robotics	19.2	33.3	14.3	21.4
Signal Processing	16.7	36.4	20.0	22.2
Systems Engineering	22.7	36.4	33.3	28.6
Telecommunications	10.0	33.3	14.3	16.7
Weapons Design	15.0	37.5	28.6	22.9

SOURCE: SURVEY QUESTION 13.

JM:ad-5
11/8/88

CHART III-9. PERCENTAGE OF LABS FOR WHICH SHORTAGES OF PERSONNEL WITH INDICATED MULTIDISCIPLINARY BACKGROUNDS ARE A SOMEWHAT SERIOUS PROBLEM

MULTIDISCIPLINARY SKILLS	ARMY	NAVY	AIR FORCE	TOTAL
Acoustics	23.1	0.0	12.5	16.3
Artificial Intelligence	30.0	21.4	20.0	25.9
Biomechanics	4.8	20.0	0.0	7.9
Ceramics	13.6	22.2	28.6	18.4
Computer Engineering	46.2	7.1	54.6	35.3
Computer Networking	40.9	50.0	50.0	45.5
Control System Engineering	31.6	20.0	66.7	45.2
Digital Communications	39.1	40.0	44.4	38.1
Fiber Optics	36.0	50.0	20.0	35.6
Geophysics	5.0	11.1	11.1	7.9
Human Factors	21.7	23.1	20.0	26.1
Infrared Manufacturing Engineering	5.0	0.0	33.3	10.8
Ocean Engineering	10.0	55.6	0.0	20.0
Physical Chemistry	14.3	30.0	30.0	22.5
Robotics	38.5	50.0	57.1	40.5
Signal Processing	45.8	36.4	30.0	40.0
Systems Engineering	36.4	27.3	44.4	35.7
Telecommunications	20.0	33.3	0.0	19.4
Weapons Design	25.0	12.5	14.3	20.0

SOURCE: SURVEY QUESTION 13.

JM:ad-6
11/8/88

CHART III-10. PERCENTAGE OF LABS FOR WHICH SHORTAGES OF PERSONNEL WITH INDICATED MULTIDISCIPLINARY BACKGROUNDS ARE NOT A SERIOUS PROBLEM

MULTIDISCIPLINARY SKILLS	ARMY	NAVY	AIR FORCE	TOTAL
Acoustics	69.2	22.2	87.5	62.8
Artificial Intelligence	33.3	0.0	10.0	20.3
Biomechanics	80.9	50.0	71.4	71.1
Ceramics	72.7	33.3	40.0	58.3
Computer Engineering	26.9	0.0	9.0	15.7
Computer Networking	36.4	0.0	10.0	20.5
Control System Engineering	63.2	10.0	22.2	48.4
Digital Communications	43.4	20.0	33.3	35.7
Fiber Optics	48.0	10.0	50.0	40.0
Geophysics	95.0	88.9	66.7	86.8
Human Factors	52.2	38.5	50.0	47.8
Infrared Manufacturing Engineering	95.0	100.0	55.5	86.5
Ocean Engineering	90.0	22.2	100.0	74.3
Physical Chemistry	81.0	66.7	60.0	72.5
Robotics	34.6	33.3	28.6	30.1
Signal Processing	33.3	9.0	30.0	34.3
Systems Engineering	22.7	0.0	22.2	16.6
Telecommuncations	70.0	33.3	85.7	63.9
Weapons Design	60.0	50.0	42.9	54.3

JM:ad-7
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SOURCE: SURVEY QUESTION 13.

IV. RECRUITMENT

IV. RECRUITMENT

A. SOURCES OF S&E

Chart IV-1 indicates that merit promotions accounted for 53 percent of the vacancies filled during 1986 and that New Hires outnumber Reassignments and Transfers by three to one in filling vacancies. The data source for this chart is the lab survey, whose question on vacancy-filling was answered incompletely by many labs. Thus, while the survey indicates that approximately 3,600 lab vacancies were filled in 1986, DMDC indicates in the next chart that almost twice that number of vacancies were filled.

In 1986, the labs had approximately 7,000 S&E job openings. Five years earlier, there were almost 4,200 openings. Chart IV-2 shows that 71 percent of the open positions were filled by Promotions and 29 percent by Hires-and-Transfers in 1986. In 1981, 62 percent of the openings were filled by Promotions and 38 percent by Hires-and-Transfers.

If we look in Chart IV-2 at filling GS-9, -11, and -12 positions, we see that about 28 percent of the openings at those levels were filled in 1986 by Hires-and-Transfers and 72 percent as by Promotions. In 1981, about 33 percent of the GS-9, -11, and -12 openings were filled by Hires-and-Transfers and 67 percent as by Promotions. When we consider filling GS-13, -14, and -15 positions, we see that 17 percent were taken by Hires-and-Transfers in 1986, which is the same as in 1981.

B. FOREIGNERS

Charts IV-3 and IV-4 show that the manpower pool of physical scientists and engineers receiving advanced degrees available to the labs is shrinking percentagewise because so many students matriculating in S&E curricula at American universities are noncitizens. Chart IV-3 indicates that of new graduates at the doctor's-degree level, 27 percent of the physical scientists and 57 percent of the engineers are not now employable by the labs because of the citizenship requirements; presumably many will eventually become employable as they acquire citizenship.

At the master's degree level, Chart IV-4 indicates that the manpower pool of new graduates is a little less restricted: 20 percent of the physical scientists and 36 percent of the engineers are not U.S. citizens.

C. RECRUITING ACTIVITIES AND PROGRAMS

Charts IV-5 through -8 give lab opinions on the effectiveness of several recruiting activities (Charts IV-5 and -6) and programs (Charts IV-7 and -8), respectively. The most effective and most used recruiting activity involves old-hand S&E contacting potential new S&E. Internship and co-op programs are the most effective and most used programs for recruiting entry-level S&E. Academic-interchange programs are the top-rated choice for recruiting journeymen S&E.

Charts IV-9, -10, and -11 indicate that co-op programs have proven to be a superior source for developing full-time, permanent S&E from part-time or temporary lab employees. Chart IV-11 shows the co-op programs are three times more effective than the alternatives for (1) converting a part-time or temporary employee to a full-time, permanent S&E and (2) retaining him or her for at least three years. However, Chart IV-9 (footnote e) indicates that Army and Navy labs had significantly less co-op employees in 1986--Army went from 306 in 1981 to 211 and the Navy went from 428 in 1981 to 300--while Air Force labs had 95 co-op employees in 1981 and 96 in 1986.

D. FACTORS INFLUENCING RECRUITS

Charts IV-12 and -13 show lab opinions of reasons S&E accept or do not accept lab employment, respectively. The top attractions in recruiting S&E are the promise of interesting work, opportunity to use their skills, availability of up-to-date equipment, good location, good lab reputation, and availability of nearby universities. Low pay is by far the leading handicap in recruiting; poor reputation of the Civil Service is the second leading handicap. While we expect that most labs have formal systems for collecting and maintaining recruiting and hiring data, we do not know the extent to which lab opinions are based on formal records or are subjective.

E. JOB OFFERS

Chart IV-14 shows that for the labs overall, and the Army and the Navy in particular, at most one out of four S&E offers (formal and informal) for lower-level jobs, viz., GS-5 to -12, are rejected. While we have found limited hard data elsewhere for comparison, that data and our collective experience indicate that an S&E-job-offer acceptance rate of 75 percent seems quite good.

The rejection rates for offers above the first three grade-level categories are fictitious in that they do not reflect the large numbers of qualified prospects who are typically considered for high-level job openings. Some prospects withdrew their candidacy to pursue other opportunities. And formal offers are not made to other high-grade candidates who are expected to reject them. Also, while the survey did not ask for separate rejection estimates to formal offers and to informal offers, we expect that informal offers are not captured in lab records, and therefore are not well represented in responses to our survey question.

F. CLASS STANDING

Charts IV-15 and IV-16 show that in 1986, as in 1981, over 75 percent of bachelor's-degree-level S&E recruited by the labs were in the top half of their classes. We assume that labs obtain class standing data from applicants' personal qualification forms. We do not know the extent to which the labs attempt to validate these data. Nor do we know the extent to which lab reports of new-hire class standing are based on formal records or are subjective.

G. HIRING TIME

Charts IV-17 through IV-20 indicate that while the Army has speeded up its hiring process since 1981 and the Navy takes about the same amount of time from decision-to-fill-a-billet until final-approval-of-the-selected-person, the Air Force has slowed its hiring process for GS 5 to 15 grade levels by about two to four months. In 1986, the elapsed hiring time to fill an SES position (until final approval of the selectee) was five months for the Navy, nine months for the Air Force, and, despite improvement since 1981, eleven months for the Army. The comparable time to hire GS grade levels 5 to 15 is three months for the Navy, two to four months for the Army, and four to six months for the Air Force.

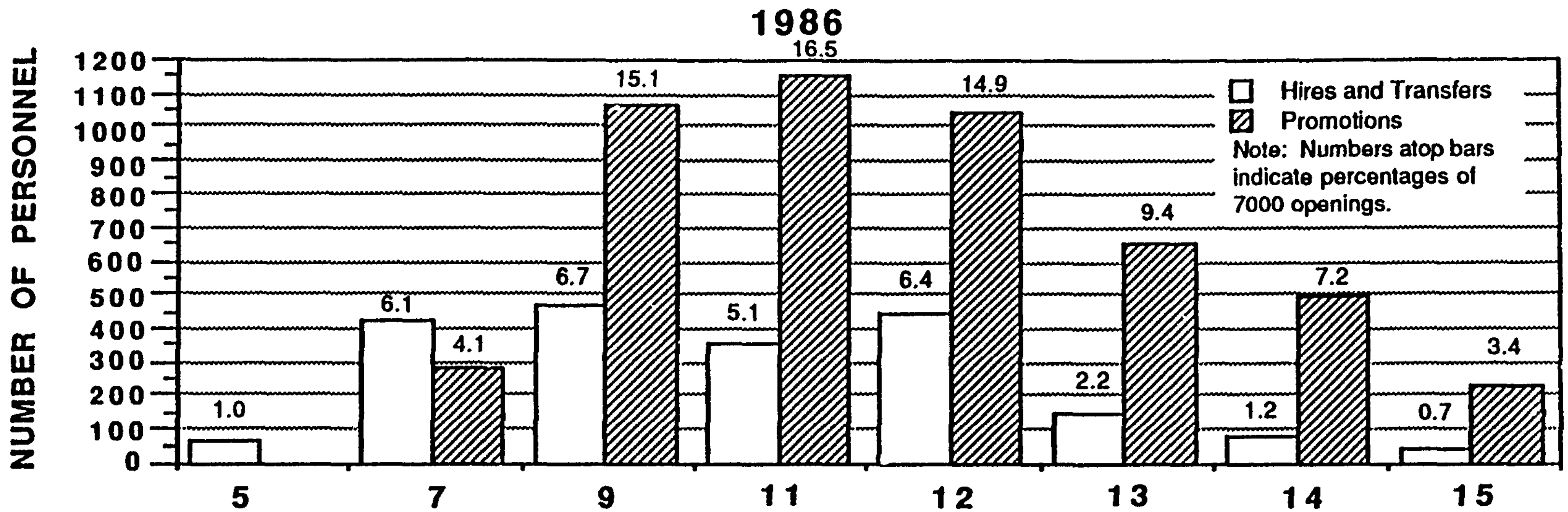
CHART IV-1. CIVILIAN S&E VACANCIES FILLED BY NEW HIRES, TRANSFERS, AND PROMOTIONS DURING 1986[a]

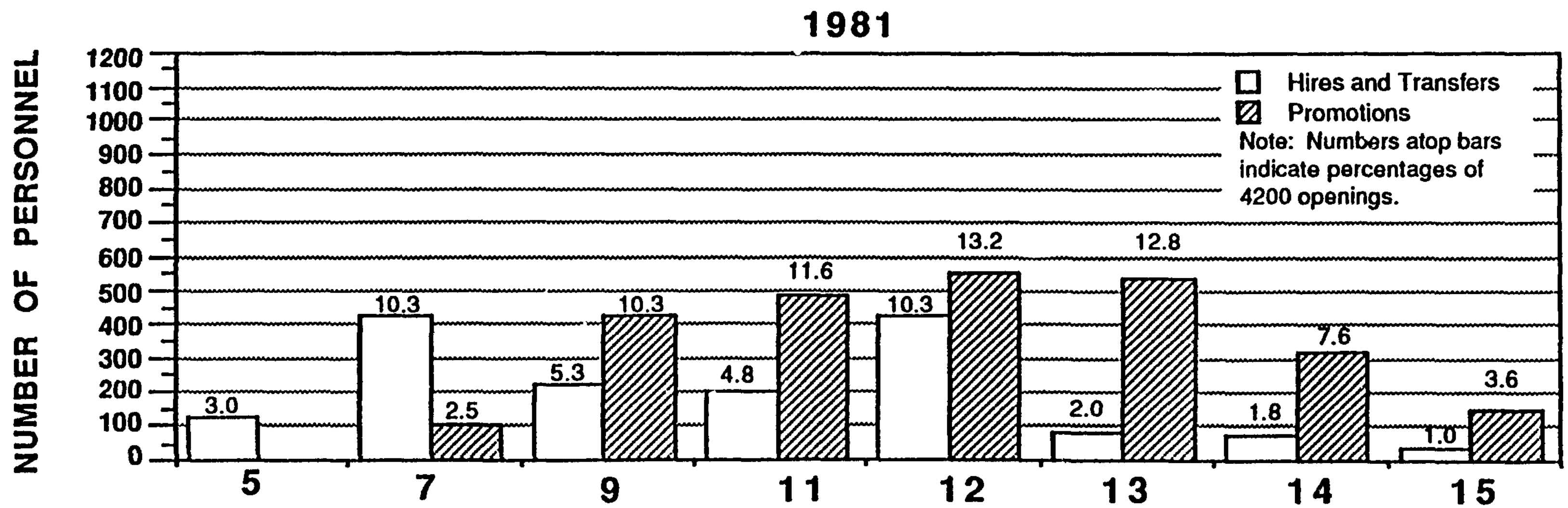
GRADE	NON-FEDERAL NEW HIRE	FEDERAL REASSIGNMENT OR TRANSFER	MERIT PROMOTION IN LABORATORY	PERSONS WITHOUT S&E DEGREES
GS 5-7	553	48	93	11
GS 7-9	195	40	241	5
GS 9-11	214	73	482	1
GS 12	257	116	361	3
GS 13	69	71	374	2
GS 14	19	36	269	2
GS 15	7	14	101	0
GS 16-18	b	b	b	b
SES	1	3	10	0
PL	b	b	b	b
TOTALS	1,302	401	1,931	24

[a] SOURCE: SURVEY QUESTION 23.
[b] NO RESPONSE.

JM:ad-2

CHART IV-2. SOURCE OF PERSONNEL FOR OPEN CIVILIAN S&E POSITIONS





JM:ad-2
6/13/89

Source: DMDC.

CHART IV-3. RECIPIENTS OF DOCTOR'S DEGREES IN SCIENCE & ENGINEERING[a]

YEAR	PHYSICAL SCIENCES				ENGINEERING			
	U.S. CITIZENS		FOREIGNERS[b]		U.S. CITIZENS		FOREIGNERS[b]	
	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT
1979	2,040		580		1,293		1,137	
		78		22		53		47
1981	1,956		589		1,170		1,243	
		77		23		48		52
1983	2,064		659		1,163		1,489	
		76		24		44		56
1985	2,040		754		1,279		1,728	
		73		27		43		57

[a] SOURCE: NATIONAL SCIENCE FOUNDATION (Ref. 10); SMALL PERCENTAGES (TYPICALLY 3%) OF RECIPIENTS WHOSE CITIZENSHIP IS UNKNOWN ARE NOT INCLUDED IN THE DATA.

[b] INCLUDES ALIENS IN THE U.S. ON PERMANENT VISAS AND NON-IMMIGRANTS IN THE U.S. ON TEMPORARY VISAS.

JM:ad-20
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CHART IV-4. RECIPIENTS OF MASTER'S DEGREES IN SCIENCE & ENGINEERING[a]

YEAR	PHYSICAL SCIENCES				ENGINEERING			
	USC & RA[b]		FOREIGNERS[c]		USC & RA[b]		FOREIGNERS[c]	
	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT
1979	4,700		706		11,287		3,952	
		87		13		74		26
1981	4,441		786		11,795		4,563	
		85		15		72		28
1983	4,498		790		13,663		5,179	
		85		15		73		27

[a] SOURCE: NATIONAL SCIENCE FOUNDATION (Ref. 10); LATEST DATA PUBLISHED IN 1983.

[b] U.S. CITIZENS AND RESIDENT ALIENS (HOLDERS OF PERMANENT VISAS).

[c] INCLUDES ONLY THOSE HOLDING TEMPORARY VISAS. NSF DATA (Ref. 4) INDICATES THAT AMONG FOREIGNERS RECEIVING Ph.D.s IN PHYSICAL SCIENCES AND ENGINEERING OVER THE DECADE 1976-1985, NON-IMMIGRANTS OUTNUMBERED IMMIGRANTS BY 3-TO-1 IN THE PHYSICAL SCIENCES FIELDS AND IN THE ENGINEERING FIELDS. WITH THIS 3-TO-1 FACTOR APPLIED TO 1983 GRADUATES, 80% OF THE PHYSICAL SCIENTISTS AND 64% OF THE ENGINEERS WOULD EXPECTEDLY BE U.S. CITIZENS.

JM:ad-21
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CHART IV-5. EFFECTIVENESS OF OUTREACH ACTIVITIES FOR RECRUITING ENTRY-LEVEL S&E[a]

ACTIVITY	ARMY		NAVY		AF		ALL LABS	
	%	$\overline{E}$	%	$\overline{E}$	%	$\overline{E}$	%	$\overline{E}$
PERSONAL CONTACT BETWEEN POTENTIAL EMPLOYEE AND S&E ALREADY ON BOARD	52		65		70		58	
		6.3		6.5		7.1		6.5
VISITS TO SCHOOLS	34		64		50		45	
		5.1		6.6		4.8		5.5
FOLLOW-UP INTERVIEWS/TOURS AT LAB.	21		43		56		33	
		4.4		5.8		5.9		5.0
RECRUITMENT AT PROFESSIONAL MEETINGS	19		27		30		23	
		3.8		4.1		5.2		4.1
NEWSPAPER/TECHNICAL JOURNAL ADS	23		19		20		21	
		4.1		3.8		3.9		4.0
FORMAL PEER REVIEW OF PAPERS, etc.	13		25		10		15	
		2.7		4.8		4.6		3.5
VISITS TO MINORITY SCHOOLS	7		23		11		12	
		2.8		3.9		3.9		3.3
VISITS TO INDUSTRY	0		11		11		4	
		1.1		2.2		2.4		1.6

[a] SOURCE: SURVEY QUESTION 19. AVERAGE EFFECTIVENESS RATINGS ($\overline{E}$) SHOWN ARE BASED ON A SCALE OF 0, NOT EFFECTIVE, TO 9, VERY EFFECTIVE; % INDICATES PERCENTAGE OF RATINGS IN THE VERY EFFECTIVE, 7-TO-9, RANGE.

JM:ad-13
11/8/88

CHART IV-6. EFFECTIVENESS OF OUTREACH ACTIVITIES FOR RECRUITING JOURNEYMAN S&E[a]

ACTIVITY	ARMY		NAVY		AF		ALL LABS	
	%	$\overline{E}$	%	$\overline{E}$	%	$\overline{E}$	%	$\overline{E}$
PERSONAL CONTACT BETWEEN POTENTIAL EMPLOYEE AND S&E ALREADY ON BOARD	65	6.7	76	7.1	73	7.1	69	6.9
RECRUITMENT AT PROFESSIONAL MEETINGS	31	5.0	31	5.4	18	5.1	29	5.1
NEWSPAPER/TECHNICAL JOURNAL ADS	24	4.3	29	4.8	20	4.5	25	4.6
FOLLOW-UP INTERVIEWS/TOURS AT LAB.	14	3.3	33	5.6	44	5.9	24	4.3
FORMAL PEER REVIEW OF PAPERS, etc.	13	2.9	50	5.8	0	4.0	20	3.8
VISITS TO SCHOOLS	7	2.8	18	3.0	20	3.6	12	2.9
VISITS TO INDUSTRY	0	1.5	10	3.2	11	2.7	4	2.1
VISITS TO MINORITY SCHOOLS	0	1.4	22	2.4	0	2.8	4	1.9

[a] SOURCE: SURVEY QUESTION 19. AVERAGE EFFECTIVENESS RATINGS ($\overline{E}$) SHOWN ARE BASED ON A SCALE OF 0, NOT EFFECTIVE, TO 9, VERY EFFECTIVE; % INDICATES PERCENTAGE OF RATINGS IN THE VERY EFFECTIVE, 7-TO-9, RANGE.

JM:ad-14
11/8/88

CHART IV-7. EFFECTIVENESS OF PROGRAMS FOR RECRUITING ENTRY-LEVEL S&E[a]

PROGRAM	ARMY		NAVY		AF		TOTAL	
	%	$\bar{E}$	%	$\bar{E}$	%	$\bar{E}$	%	$\bar{E}$
CO-OP PROGRAMS	30	2.3	33	5.3	60	6.6	38	5.2
INTERNSHIP PROGRAMS	44	4.9	43	4.9	25	3.4	40	4.7
RESEARCH CONTRACTS WITH UNIVERSITIES FOR SERVICES OF S&E STUDENTS	24	3.2	27	4.7	50	6.0	30	4.1
ACADEMIC INTERCHANGE PROGRAM	13	2.8	30	4.4	45	4.8	24	3.6
STUDENT VOLUNTEER/TRAINEE PROGRAMS	6	2.8	30	4.2	22	3.3	14	3.2
MINORITY PROGRAMS	9	2.9	0	2.8	22	4.4	10	3.2
FEDERAL JUNIOR FELLOWSHIP PROGRAM	8	2.3	14	2.7	0	3.3	8	2.6

[a] SOURCE: SURVEY QUESTION 19. AVERAGE EFFECTIVENESS RATINGS ($\bar{E}$) SHOWN ARE BASED ON A SCALE OF 0, NOT EFFECTIVE, TO 9, VERY EFFECTIVE; % INDICATES PERCENTAGE OF RATINGS IN THE VERY EFFECTIVE, 7-TO-9, RANGE.

CHART IV-8. EFFECTIVENESS OF PROGRAMS FOR RECRUITING JOURNEYMAN S&E[a]

PROGRAM	ARMY		NAVY		A.F.		TOTAL	
	%	$\bar{E}$	%	$\bar{E}$	%	$\bar{E}$	%	$\bar{E}$
ACADEMIC INTERCHANGE PROGRAM	40	4.7	8	4.6	55	6.0	35	4.9
RESEARCH CONTRACTS WITH UNIVERSITIES FOR SERVICES OF S&E STUDENTS	26	3.2	2.2	3.6	40	5.3	28	3.7
CO-OP PROGRAMS	6	2.8	0	1.4	20	3.1	9	2.7
MINORITY PROGRAMS	13	2.5	0	2.6	11	3.7	11	2.7
INTERNSHIP PROGRAMS	25	2.8	0	1.8	13	2.1	20	2.6
FEDERAL JUNIOR FELLOWSHIP PROGRAM	5	1.1	0	0.3	0	1.1	3	1.0
STUDENT VOLUNTEER/TRAINEE PROGRAMS	0	0.9	0	0.3	11	1.6	3	1.0

[a] SOURCE: SURVEY QUESTION 19. AVERAGE EFFECTIVENESS RATINGS ($\bar{E}$) SHOWN ARE BASED ON A SCALE OF 0, NOT EFFECTIVE, TO 9, VERY EFFECTIVE; % INDICATES PERCENTAGE OF RATINGS IN THE VERY EFFECTIVE, 7-TO-9, RANGE.

JM:ad-16
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CHART IV-9. CONVERSION OF PART-TIME OR TEMPORARY EMPLOYEES TO FULL-TIME S&E[a]

LABS	PART-TIME PERMANENT		TEMPORARY					
			CO-OP		AIDE		OTHER[b]	
	N[c]	%[d]	N[c]	%[d]	N[c]	%[d]	N[c]	%[d]
ARMY	64		211		63		236	
		31.9		68.7		18.5		27.7
NAVY	169		300		86		333	
		15.2		46.0		17.4		5.9
AIR FORCE	16		96		20		96	
		6.3		23.5		0.0		19.8
ALL	249		607[e]		169		666	
		18.9		50.4		15.8		15.6

[a] SOURCE: SURVEY QUESTION 4.
[b] FULL-TIME OR PART-TIME.
[c] NUMBER OF EMPLOYEES IN CATEGORY INDICATED.
[d] LAB-ESTIMATED AVERAGE PERCENTAGE OF PART-TIME, PERMANENT OR TEMPORARY EMPLOYEES WHO CONVERTED OVER A 5-YEAR PERIOD.
[e] THE 1981 LAB SURVEY SHOWED A TOTAL OF 829 CO-OP EMPLOYEES--306 ARMY, 428 NAVY, AND 95 AIR FORCE.

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CHART IV-10. PERCENTAGE OF FULL-TIME, PERMANENT S&E WITH THREE OR MORE YEARS SERVICE AFTER CONVERTING FROM PART-TIME OR TEMPORARY EMPLOYMENT[a]

LABS	PART-TIME PERMANENT	TEMPORARY		
		CO-OP	AIDE	OTHER[b]
ARMY	78.4	52.9	55.6	59.5
NAVY	84.5	86.2	80.0	64.6
AIR FORCE	100.0	91.2	0.0	83.9
ALL	82.0	70.9	72.8	69.3

[a] SOURCE: SURVEY QUESTION 4. PERCENTAGES ARE LAB ESTIMATES OF THOSE S&E WHO EARLIER CONVERTED AND WHO HAVE AT LEAST THREE YEARS SERVICE AS FULL-TIME, PERMANENT S&E.
[b] FULL-TIME OR PART-TIME.

JM:ad-18
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CHART IV-11. EFFECTIVENESS OF RECRUITING S&E FROM PART-TIME AND TEMPORARY EMPLOYMENT PROGRAMS[a]

LABS	PART-TIME PERMANENT			TEMPORARY								
				CO-OP			AIDE			OTHER[e]		
	P(C)[b]	P(S/C)[c]	P(CS)[d]	P(C)	P(S/C)	P(CS)	P(C)	P(S/C)	P(CS)	P(C)	P(S/C)	P(CS)
ARMY	.319	.784		.687	.529		.185	.556		.277	.595	
			.250			.363			.103			.165
NAVY	.152	.845		.460	.862		.174	.800		.059	.646	
			.128			.397			.139			.038
AIR FORCE	.063	1.000		.235	.912		0	0		.198	.839	
			.063			.214			0			.166
ALL	.189	.649		.504	.709		.158	.728		.156	.693	
			.123			.357			.115			.108

[a] METHOD OF CALCULATION: PROBABILITY (P) THAT A SCIENTIST OR ENGINEER CONVERTS (C) FROM PART-TIME OR TEMPORARY TO FULL-TIME, PERMANENT EMPLOYMENT AND STAYS (S) AT LEAST THREE YEARS. PROBABILITIES, P(C) AND P(S/C), ARE LAB ESTIMATES BASED ON LAST FIVE YEARS OF EXPERIENCE; THE PROBABILITY STATEMENT IS P(C) x P(S/C) = P(CS).

[b] FROM CHART IV-9.

[c] FROM CHART IV-10.

[d] COMPOUND PROBABILITY.

[e] FULL-TIME OR PART-TIME.

JM:ad-19

CHART IV-12. RECRUITMENT OF S&E PERSONNEL, REASONS FOR ACCEPTING POSITION[a]

REASON[b]	ARMY	NAVY	AF	ALL LABS
TYPE OF WORK	7.2	8.2	8.3	7.5
USE OF SKILLS	6.8	7.1	7.2	6.9
UP-TO-DATE EQUIPMENT	6.1	6.4	7.4	6.4
LOCATION OF EMPLOYMENT	6.0	6.8	6.5	6.3
REPUTATION OF LABORATORY	6.0	6.4	7.3	6.3
PROXIMITY TO UNIVERSITIES	4.8	8.7	5.5	6.1
TRAINING OPPORTUNITIES	5.9	6.1	6.0	6.0
OPPORTUNITY FOR ADVANCEMENT	6.0	6.0	6.2	6.0
JOB SECURITY	5.7	6.1	6.5	6.0
MODERN FACILITIES	5.5	5.9	7.3	5.9
OPPORTUNITY FOR CONTINUED EDUCATION	5.8	5.6	6.2	5.8
SALARY	5.2	5.2	5.5	5.2
COST OF LIVING IN LOCALITY	4.5	3.9	6.7	4.7
AFFORDABLE HOUSING NEARBY	4.7	3.9	4.6	4.4
LACK OF OTHER OFFERS	4.5	4.4	4.1	4.3
PROXIMITY TO COMPETING INDUSTRY/GOVERNMENT	3.4	3.4	3.8	3.5
REPUTATION OF CIVIL SERVICE	3.2	2.4	3.4	3.0
FACILITY NEAR TRANSPORTATION	2.6	2.2	1.5	2.3

[a] SOURCE: SURVEY. AVERAGE RATINGS BASED ON A SCALE OF 0, NOT IMPORTANT, TO 9, VERY IMPORTANT, ARE SHOWN.
[b] AS STATED IN SURVEY QUESTION 21.

JM:ad-10
11/8/88

CHART IV-13. RECRUITMENT OF S&E PERSONNEL, REASONS FOR NOT ACCEPTING POSITION[a]

REASON[b]	ARMY	NAVY	AF	ALL LABS
SALARY	6.3	7.8	7.7	7.0
REPUTATION OF CIVIL SERVICE	5.3	4.5	6.2	5.2
LOCATION OF EMPLOYMENT	4.7	4.8	5.4	4.8
OPPORTUNITY FOR ADVANCEMENT	4.4	4.4	5.3	4.6
COST OF LIVING IN LOCALITY	4.4	3.9	4.7	4.5
AFFORDABLE HOUSING NEARBY	4.3	4.9	4.0	4.4
TYPE OF WORK	4.5	3.6	4.7	4.2
USE OF SKILLS	4.1	3.8	5.3	4.2
PROXIMITY TO COMPETING INDUSTRY/GOVERNMENT	2.6	3.7	3.9	3.1
MODERN FACILITIES	3.1	2.3	4.7	3.1
UP-TO-DATE EQUIPMENT	2.9	2.9	4.2	3.1
PROXIMITY TO UNIVERSITIES	2.6	2.7	5.6	3.1
OPPORTUNITY FOR CONTINUED EDUCATION	2.4	1.7	5.9	2.8
REPUTATION OF LABORATORY	2.4	1.6	4.6	2.6
FACILITY NEAR TRANSPORTATION	2.5	2.2	2.1	2.4
TRAINING OPPORTUNITIES	2.3	1.8	4.3	2.3
JOB SECURITY	2.0	1.6	4.4	2.3

[a] SOURCE: SURVEY. AVERAGE RATINGS BASED ON A SCALE OF 0, NOT IMPORTANT, TO 9, VERY IMPORTANT, ARE SHOWN.

[b] AS STATED IN SURVEY QUESTION 21.

JM:ad-11
11/8/88

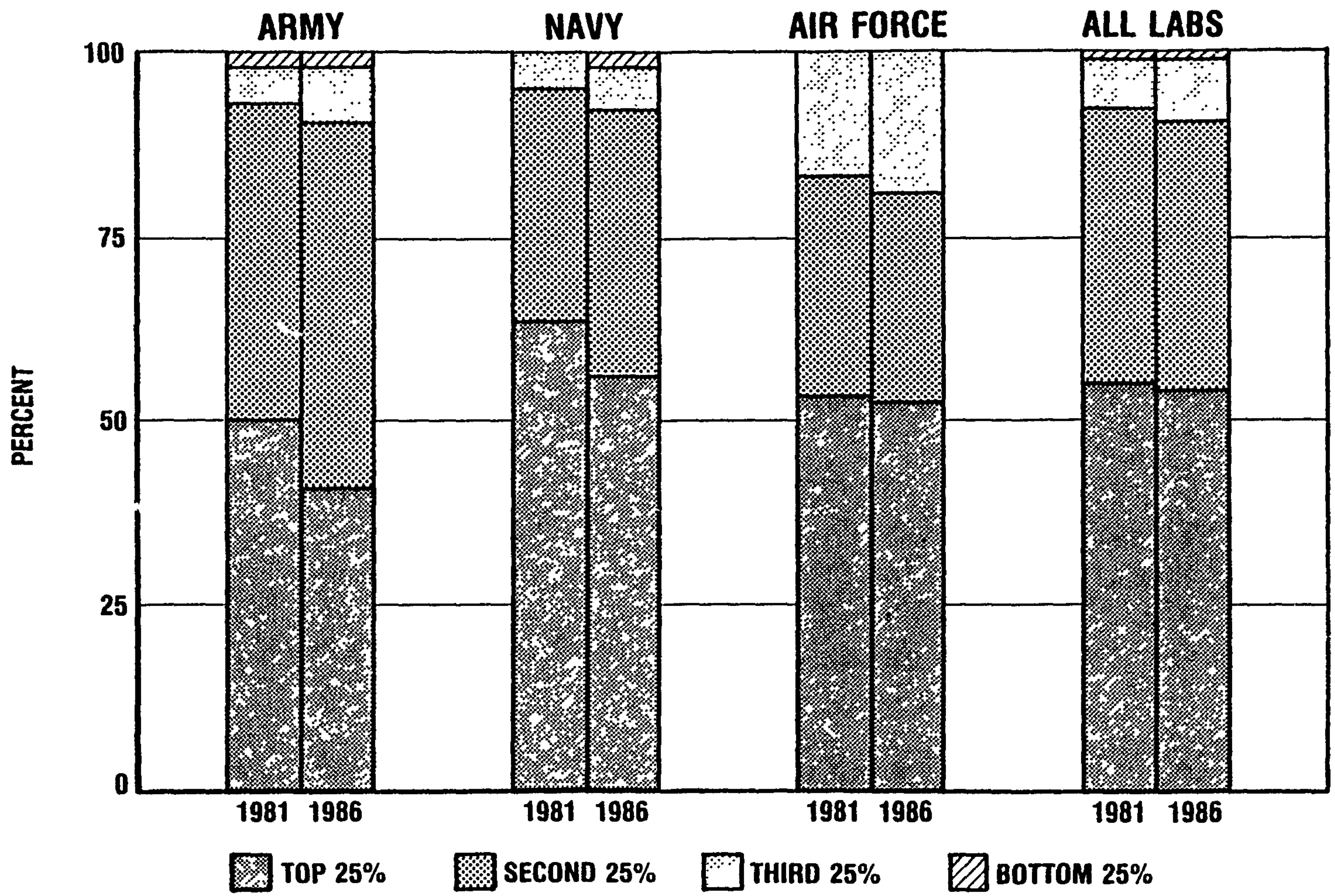
CHART IV-14. PERCENTAGE OF REJECTIONS OF JOB OFFERS TO CIVILIAN S&E DURING 1986[a]

GS GRADE LEVEL	ARMY	NAVY	AF	ALL LABS
5-7	27.2	25.4	35.4	27.4
9-11	19.4	20.9	38.7	22.5
12	21.7	22.2	41.0	24.4
13	12.3	15.8	38.0	16.3
14	4.5	5.9	25.0	8.0
15	4.6	3.5	0.0	3.6
16-18	0.0	0.0	0.0	0.0
PL	0.0	0.0	0.0	0.0
SES	0.0	0.0	0.0	0.0

[a] SOURCE: SURVEY QUESTION 20. "JOB OFFERS" INCLUDE FORMAL AND INFORMAL OFFERS. REJECTION RATES FOR GRADE LEVELS ABOVE THE FIRST THREE CATEGORIES ARE INCREASINGLY FICTITIOUS. THEY DO NOT REFLECT THE HIGH INCIDENCE OF WITHDRAWAL (BECAUSE JOB CONDITIONS MIGHT NOT BE SUITABLE OR OTHER JOB OPPORTUNITIES APPEAR ATTRACTIVE) OF S&E WHOSE EXPERIENCE AND/OR ADVANCED-DEGREE TRAINING IN SCARCE-SKILL DISCIPLINES GIVEN THEM LEVERAGE IN THE JOB SEARCH. NOR DO THE RATES REFLECT THE RELUCTANCE TO MAKE FORMAL OFFERS TO HIGH-GRADE CANDIDATES WHO ARE EXPECTED TO REJECT THEM.

JM:ad-12
11/8/88

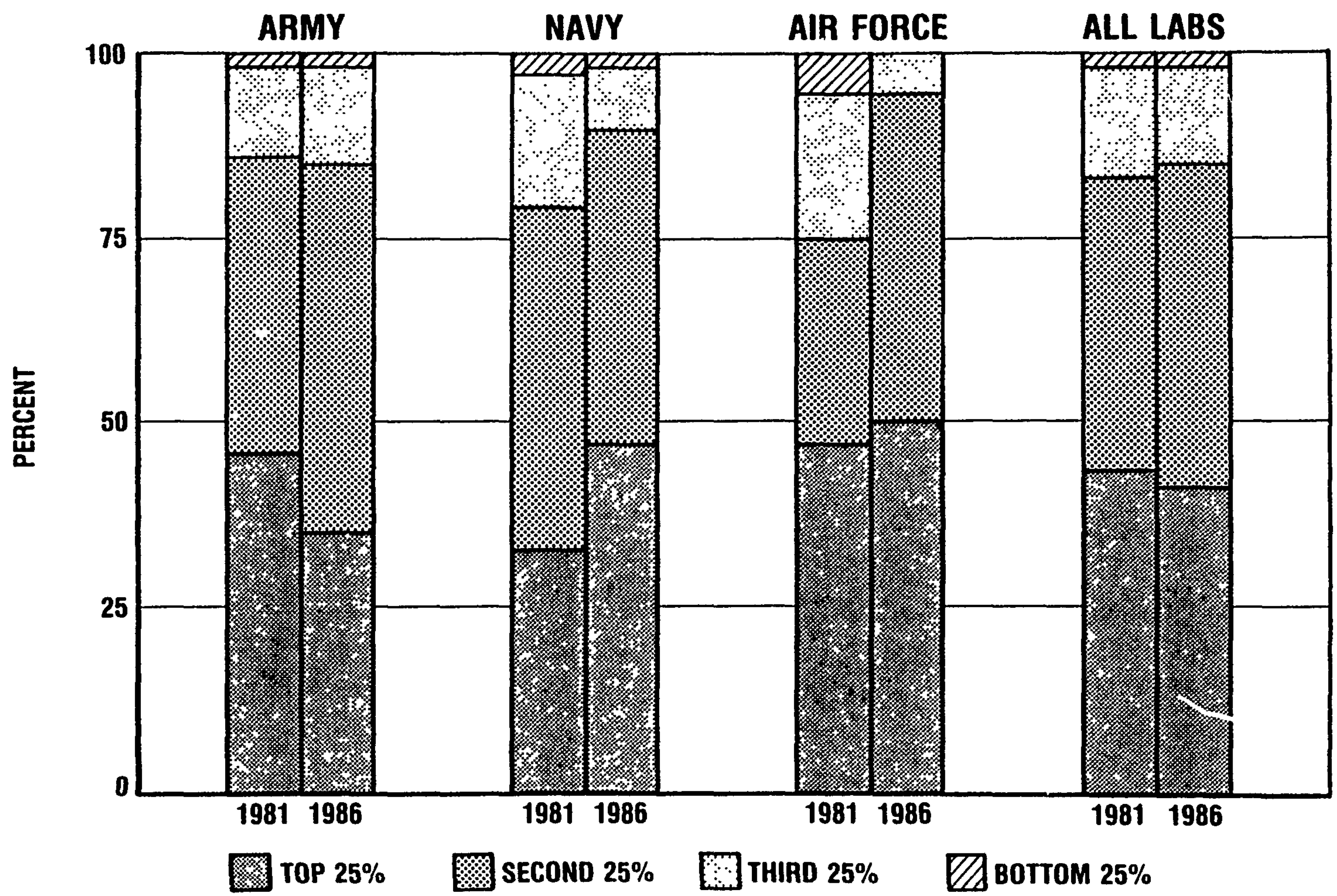
CHART IV-15. CLASS STANDING, BY QUARTER, OF SCIENTISTS WITH NEWLY ACQUIRED BACHELOR'S DEGREES



SOURCE: 1981 DATA FROM REF. 1; 1986 DATA SURVEY QUESTION 24.

11-15-88-1

CHART IV-16. CLASS STANDING, BY QUARTER, OF ENGINEERS WITH NEWLY ACQUIRED BACHELOR'S DEGREES



SOURCE: 1981 DATA FROM REF. 1; 1986 DATA FROM SURVEY QUESTION 24.

11-15-88-2

CHART IV-17. AVERAGE TIME IN DAYS TO HIRE S&E IN ALL DoD LABS

ACTIVITY \ GRADE LEVEL	GS 5-7		GS 9-12		GS 13-15		PL/SES/GS 16-18	
	1981	1986	1981	1986	1981	1986	1981	1986
INTERNAL PROCESSING PRIOR TO ADVERTISING	33	21	30	30	24	34	79	80
FROM ADVERTISING TO BEGINNING OF REVIEW PROCESS	32	31	33	41	47	49	62	103
REVIEW AND SELECTION PROCESS	36	17	18	17	30	24	48	34
APPROVAL ABOVE LAB LEVEL	16	7	9	9	16	18	130	52
<u>TOTAL</u> ELAPSED TIME FROM START TO FINAL APPROVAL	117	76	90	97	117	125	319	269
FROM FINAL APPROVAL UNTIL PERSON REPORTS TO WORK	47	31	27	33	30	36	30	39
<u>TOTAL</u> ELAPSED TIME	164	107	117	130	147	161	349	308

SOURCE: SURVEY QUESTION 18.

JM:kg-74
11/14/88

CHART IV-18. AVERAGE TIME IN DAYS TO HIRE S&E IN ARMY LABS

ACTIVITY \ GRADE LEVEL	GS 5-7		GS 9-12		GS 13-15		PL/SES/GS 16-18	
	1981	1986	1981	1986	1981	1986	1981	1986
INTERNAL PROCESSING PRIOR TO ADVERTISING	54	17	38	23	35	28	163	99
FROM ADVERTISING TO BEGINNING OF REVIEW PROCESS	55	29	40	36	43	54	40	129
REVIEW AND SELECTION PROCESS	44	16	19	17	28	26	20	53
APPROVAL ABOVE LAB LEVEL	36	9	11	11	35	24	310	55
TOTAL ELAPSED TIME FROM START TO FINAL APPROVAL	189	71	108	87	141	132	533	336
FROM FINAL APPROVAL UNTIL PERSON REPORTS TO WORK	82	38	36	39	30	36	19	54
TOTAL ELAPSED TIME	271	109	144	126	171	168	552	390

SOURCE: SURVEY QUESTION 18.

JM:kg-75
11/14/88

CHART IV-19. AVERAGE TIME IN DAYS TO HIRE S&E IN NAVY LABS

GRADE LEVEL / ACTIVITY	GS 5-7		GS 9-12		GS 13-15		PL/SES/GS 16-18	
	1981	1986	1981	1986	1981	1986	1981	1986
INTERNAL PROCESSING PRIOR TO ADVERTISING	19	23	24	25	16	31	41	38
FROM ADVERTISING TO BEGINNING OF REVIEW PROCESS	18	30	29	32	38	37	66	50
REVIEW AND SELECTION PROCESS	40	21	19	16	28	21	34	17
APPROVAL ABOVE LAB LEVEL	1	9	10	8	1	2	34	53
TOTAL ELAPSED TIME FROM START TO FINAL APPROVAL	78	83	82	81	83	91	175	158
FROM FINAL APPROVAL UNTIL PERSON REPORTS TO WORK	16	16	15	16	30	29	31	30
TOTAL ELAPSED TIME	94	99	97	97	113	120	206	188

SOURCE: SURVEY QUESTION 18.

JM:kg-76
11/14/88

CHART IV-20. AVERAGE TIME IN DAYS TO HIRE S&E IN AIR FORCE LABS

ACTIVITY \ GRADE LEVEL	GS 5-7		GS 9-12		GS 13-15		PL/SES/GS 16-18	
	1981	1986	1981	1986	1981	1986	1981	1986
INTERNAL PROCESSING PRIOR TO ADVERTISING	14	63	18	73	20	84	85	121
FROM ADVERTISING TO BEGINNING OF REVIEW PROCESS	9	39	23	77	67	68	79	120
REVIEW AND SELECTION PROCESS	13	15	13	17	37	25	139	18
APPROVAL ABOVE LAB LEVEL	1	2	2	2	9	11	199	10
TOTAL ELAPSED TIME FROM START TO FINAL APPROVAL	37	119	56	169	133	188	502	269
FROM FINAL APPROVAL UNTIL PERSON REPORTS TO WORK	29	30	27	41	30	47	43	25
TOTAL ELAPSED TIME	66	149	83	210	163	235	545	294

SOURCE: SURVEY QUESTION 18.

JM:kg-77
11/14/88

V. RETENTION

V. RETENTION

A. LEAVERS

Chart V-1 shows that in 1986 about eight percent of the civilian S&E workforce (source: DMDC) and 33 percent of the military S&E workforce (source: the 1986 survey) left the labs. Chart V-2, which contains survey-provided civilian S&E separations by grade level and by reason for 1986, shows 1,853 civilian separations, vis-à-vis 1,984 from DMDC in Chart V-1.

Chart V-3 indicates that over the 1978-1986 period, resignations accounted for about 46 percent of the yearly separations, retirements accounted for 36 percent, transfers 12 percent, and death and discharge six percent.

Chart V-2 indicates that in 1986 the labs say that 31 percent of their departing S&E left to work in industry, 30 percent retired, and 20 percent transferred either to another lab or to a nonlab DoD agency.

If we compare 1986-departure statistics from the survey in Chart V-2 with 1986 separation data from DMDC in Chart V-3, we find agreement in the rank-order of reasons for separation. While differences in magnitude of the percentage breakdown may be due to some extent to different categorization systems--DMDC uses five separation reasons and our survey question gave the labs eight reasons--and to differences in counting rules, we are unable to explain why the labs say that in 1986 retirement accounted for 30 percent of S&E separations whereas DMDC files indicate that percentage is 38.

Chart V-4 summarizes personnel transactions from DMDC for various grades of civilian S&E. A comparison with 1981 aggregates indicates that the 1986 lab loss rate (9.8 percent) was 53 percent higher than the 1981 rate (6.4 percent). This large jump motivated our obtaining DMDC data for the 1981-1988 period. Charts V-5 and -6 show S&E losses--which, as in

Chart V-4, include resignation, retirement, transfer, death, and discharge as the five reasons that account for all losses--for calendar years 1981-87.

B. RESIGNATION AND RETIREMENT

Because losses from resignation and retirement are of particular concern in personnel policymaking, Charts V-7 through -12 show resignation and retirement statistics for the CY 1981-88 period.

Charts V-7 (table) and V-9 (bar-chart form of the same data) show that resignations from all grade levels increased from 2.1 percent in 1981 to 3.5 percent in 1985 after which the resignation rate dropped to 2.8 percent in 1986 and then to 2.4 percent in 1987 and 1988.

Charts V-8 (table) and V-9 (bar-chart form of the same data) show that retirements increased from 1.3 percent in 1981 and 1.1 percent in 1982 to 2.2 percent in 1988.

Chart V-13 indicates that interesting work, opportunity to use their skills, job security, lab reputation, and opportunity to use modern equipment are the five leading factors that foster S&E retention.

Charts V-14 and V-15 show why S&E resign from the labs. Inadequate compensation and lack of advancement opportunities are the leading reasons for S&E resignations from the labs of all the services (Chart V-14) and at all grade levels (Chart V-15).

C. PROMOTIONS

Chart V-16 shows that the promotion rates of all GS grades from 9 to 15 have increased from 1981 to 1986. The promotion rate increases have been 15-, 28-, 47-, 52-, 8-, and 44-percent for Grade Levels 9, 11, 12, 13, 14, and 15, respectively.

Chart V-17 shows that two-thirds of the high-grade S&E are nonsupervisory. Chart V-18 indicates lab responses to an open-ended survey question that asked for a description of policies for promoting S&E to high grades without supervisory responsibilities.

D. PROBLEMS

Charts V-19 and -20 indicate lab ratings of a matrix of problems and impacts, all of which were preselected following a review of subjective lab responses to open-ended questions about problems in the earlier lab survey.

Charts V-21, -22, and -23 indicate lab beliefs that the leading effects of lab-system restraints--viz., authorization ceilings, limited GS 13-15 positions, and rigidities and repressions of bureaucracy--are a hindrance to recruitment and retention, failure to promote deserving S&E, and impairment of S&E morale.

E. DIRECTORS' VIEWS

Lab directors were asked to comment personally and narratively on two areas concerning personnel: (1) to identify aspects of policy, procedures, management, or organization that impact their ability to resolve S&E problems and (2) to assess S&E status, concerns, and issues. While the ring of authority and sincerity and the articulate and often blunt commentary make the directors' responses very interesting individually, we have developed a statistical sense of their comments in Charts V-24 and -25.

While in Charts V-19 through -23 we talked about recruitment and retention difficulties and low morale as "problems" whose causes were low pay, authorization ceilings, etc., the lab directors talk of the latter items as problems whose consequences are difficulties in recruitment and retention, low morale, etc.

In developing a statistical sense of lab directors' comments a dual-scoring approach was used. We weighted each lab (1) equally and (2) in proportion to its S&E population when its director discussed a problem or a consequence. In cases of substantial differences between DMDC and survey inputs on lab S&E population, we used the source that was most consistent with populations in past years.

Chart V-24 indicates that, with regard to the first area of S&E problems, 46 of 66 directors, whose labs account for 87 percent of the total S&E population, see low pay as the principal problem. Manpower constraints, centralized management, high-grade limits are the next most serious problems.

For the second area of S&E problems--viz., status, concerns, or issues--Chart V-25, which reflects the same dual-weighting approach, indicates that authorization ceilings, personnel decisionmaking by remote management, and budget uncertainty are problems that directors discussed most often.

CHART V-1. SEPARATION OF S&E BY SERVICE DURING 1986

LABS	CIVILIAN			MILITARY[c]			ALL S&E		
	POP[a]	SEP[b]	%	POP	SEP	%	POP	SEP	%
ARMY	8,396	917	10.9	512	105	20.5	8,908	1,022	11.4
NAVY	13,608	818	6.0	242	57	19.4	13,850	865	6.2
AIR FORCE	3,061	213	7.0	969	241	24.9	4,030	454	11.3
ALL	25,065	1,948	7.8	1,723	393	22.8	26,788	2,341	8.7

[a] POP = POPULATION; FROM DMDC.
[b] SEP = SEPARATIONS; FROM DMDC.
[c] FROM SURVEY QUESTIONS 11 AND 26.

JM:kg-28
11/9/88

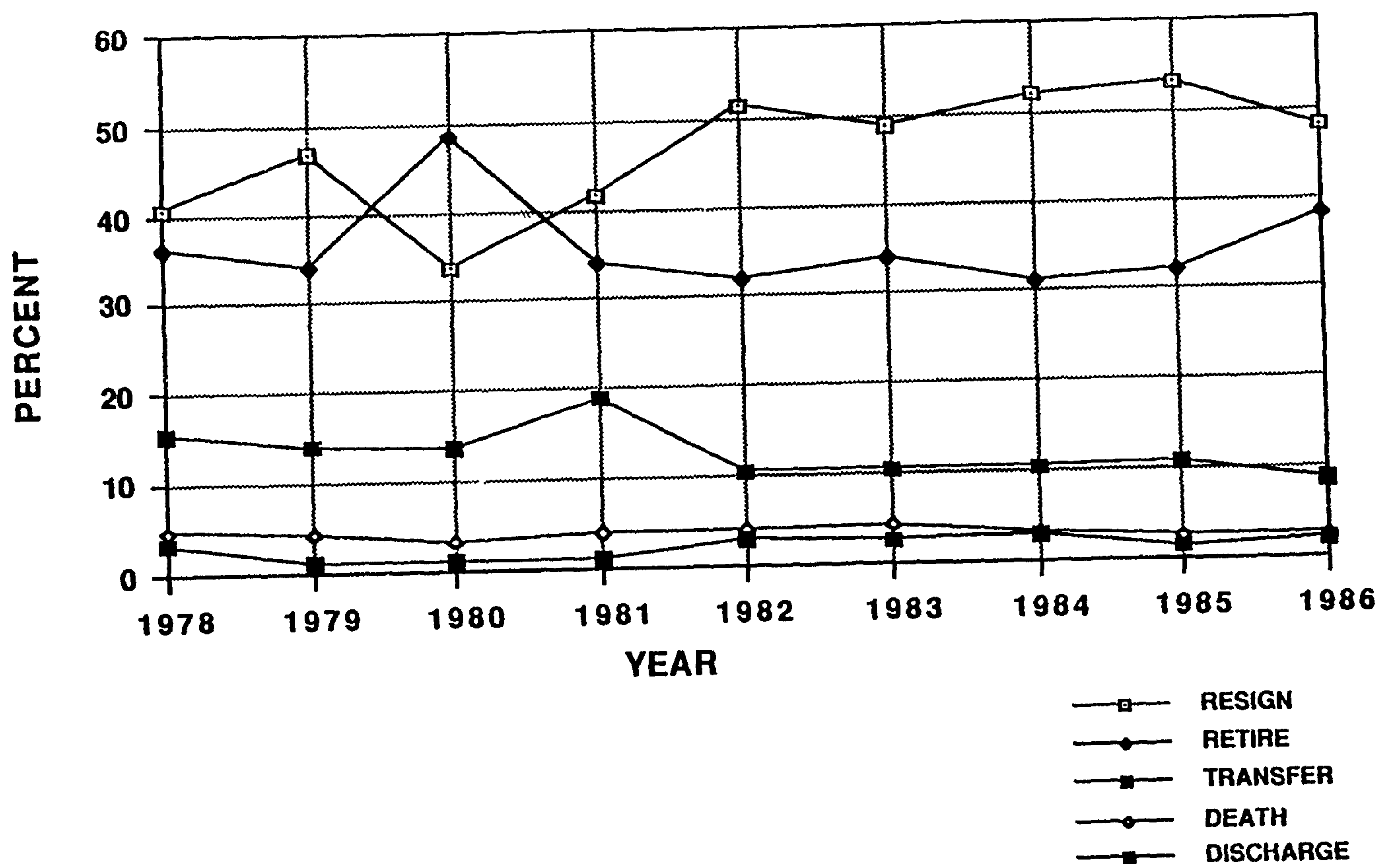
CHART V-2. CIVILIAN S&E SEPARATIONS IN 1986

REASON	NUMBER OF SEPARATIONS BY GS GRADE								TOTAL	
	5	7	9	11	12	13	14	15	NUMBER	PERCENT
WORK IN INDUSTRY	14	64	81	112	147	87	43	24	572	30.9
RETIRED	0	0	6	22	101	200	134	87	550	29.7
TRANSFERRED TO NON-LAB DoD AGENCY	1	13	11	34	82	47	25	10	223	12.0
TRANSFERRED TO ANOTHER LAB	1	5	15	29	50	23	16	3	141	7.6
DEPARTED FOR ADDITIONAL EDUCATION	2	12	11	16	171	2	0	0	60	3.2
DECEASED OR ILLNESS	0	1	3	5	13	14	0	6	42	2.3
WORK IN EDUCATIONAL INSTITUTION	0	0	3	2	3	5	3	3	19	1.0
OTHER	10	24	34	42	79	41	12	3	245	13.2
TOTAL	28	119	164	262	492	419	233	136	1,853	99.9

SOURCE: SURVEY QUESTION 27.

JM:kg-27
11/9/88

CHART V-3. REASONS FOR SEPARATION OF CIVILIAN S&E



SOURCE: DMDC.

CHART V-4. CIVILIAN S&E LOSS FROM LAB SYSTEM BY GRADE LEVEL, 1981 AND 1986

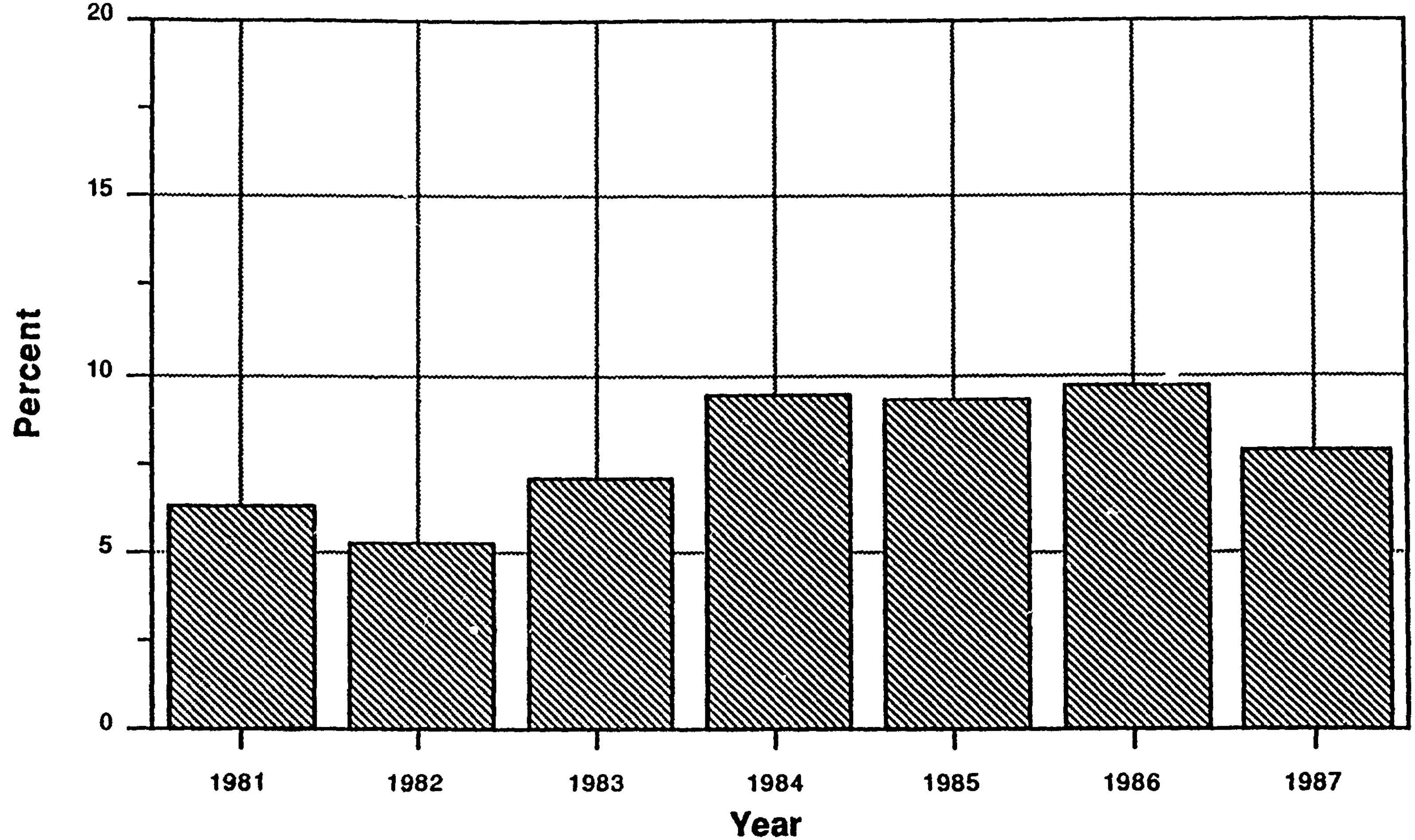
GS GRADE LEVEL	END STRENGTH		LOSS FROM LAB SYSTEM DURING		LOSS RATE, PERCENT		LOSS DISTRIBUTION, PERCENT	
	1980	1985	1981	1986	1981	1986	1981	1986
5	124		23		18.5		1.7	
		365		43		11.8		1.7
7	564		72		12.8		5.3	
		1,318		129		9.8		5.2
9	868		65		7.5		4.8	
		1,798		211		11.7		8.5
11	1,875		134		7.1		9.8	
		2,831		275		9.7		11.1
12	7,544		475		6.3		34.8	
		6,743		636		9.4		25.7
13	6,050		319		5.3		23.4	
		6,325		572		9.0		23.1
14	3,071		174		5.7		12.7	
		4,089		418		10.2		16.9
15	1,282		104		8.1		7.6	
		1,717		191		11.1		7.7
TOTAL	21,378		1,366		6.4		100	
		25,186		2,475		9.8		100

SOURCE: DMDC.

JM:kg-29
11/9/88

CHART V-5. LOSS RATE OF LAB CIVILIAN S&E IN CALENDAR YEARS 1981-87, ALL GRADE LEVELS

(PERCENT OF YEAR-END STRENGTH)

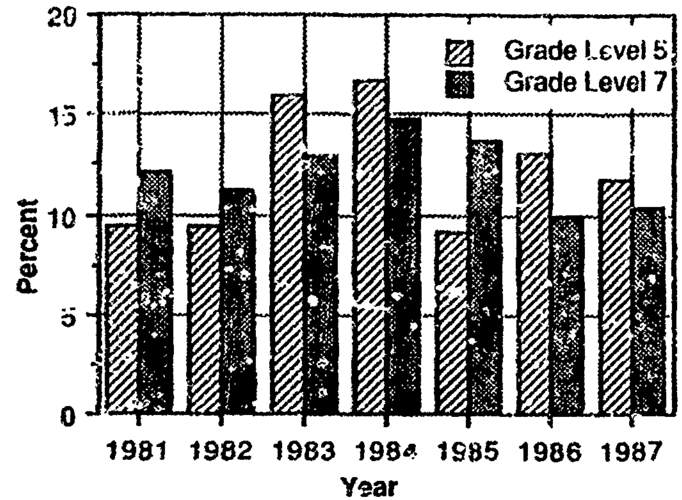


SOURCE: DMDC.

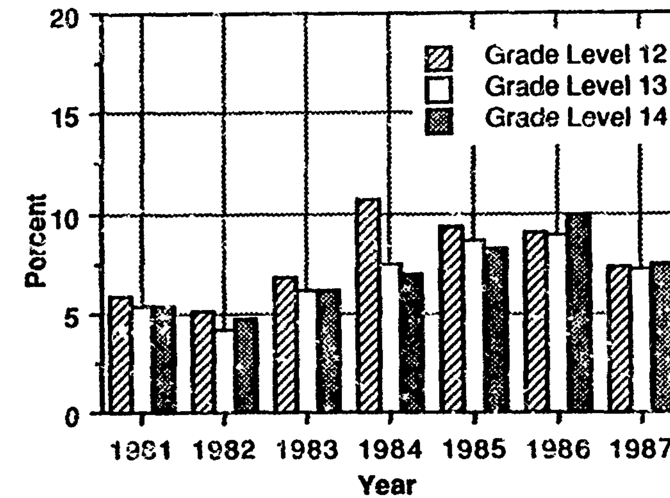
JM:ad-1
12/6/88

CHART V-6. LOSS RATE OF LAB CIVILIAN S&E IN CALENDAR YEARS 1981-87, BY GRADE LEVEL

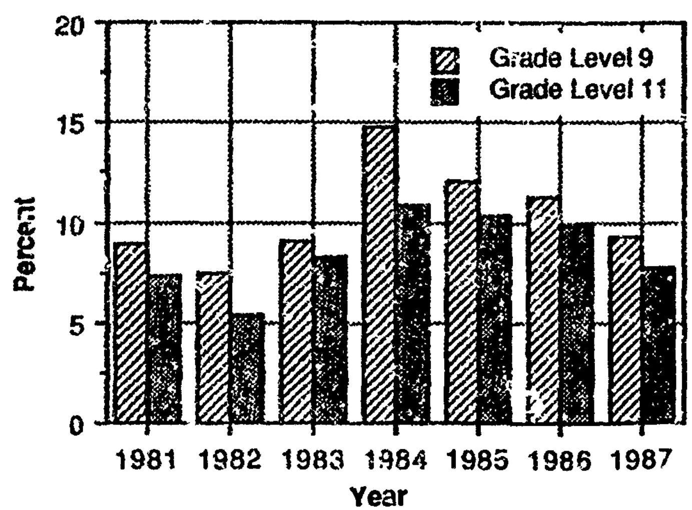
(PERCENT OF YEAR-END STRENGTH)



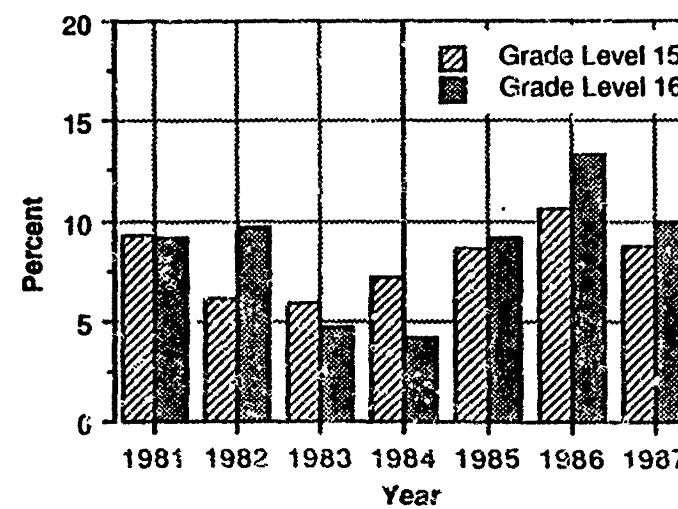
GRADE LEVELS 5 AND 7



GRADE LEVELS 12, 13, AND 14



GRADE LEVELS 9 AND 11



GRADE LEVELS 15 AND 16

JM:ad-6
12/6/88

SOURCE: DMDC.

CHART V-7. 1981-87 RESIGNATIONS BY GRADE LEVEL[a]

GRADE, GS	1981			1982			1983			1984		
	END STRENGTH 1980	RESIGNED		END STRENGTH 1981	RESIGNED		END STRENGTH 1982	RESIGNED		END STRENGTH 1983	RESIGNED	
		N	%		N	%		N	%		N	%
5	117	6	5.1	138	6	4.3	187	20	10.7	287	26	9.1
7	501	35	7.0	543	36	6.6	633	48	7.6	980	96	9.8
9	890	43	4.8	957	47	4.9	1,083	54	5.0	1,345	113	8.4
11	1,935	53	2.7	1,931	40	2.1	2,017	68	3.4	2,134	102	4.8
12	7,640	147	1.9	7,229	145	2.0	7,297	160	2.2	7,100	217	3.1
13	5,382	69	1.3	6,022	63	1.0	6,175	75	1.2	6,206	84	1.4
14	2,787	37	1.3	3,318	38	1.1	3,370	37	1.1	3,801	47	1.2
15	1,392	34	2.4	1,619	33	2.0	1,453	13	0.9	1,636	17	1.0
16	11	0	0	31	0	0	171	0	0	71	1	1.4
ALL	20,655	424	2.1	21,738	408	1.9	22,386	475	2.1	23,560	703	3.0

[a] CALENDAR YEARS. SOURCE: DMDC.

JM:kg-1
6/2/89

CHART V-7. 1981-87 RESIGNATIONS BY GRADE LEVEL[a] (Continued)

GRADE, GS	1985			1986			1987			1988		
	END STRENGTH 1984	RESIGNED		END STRENGTH 1985	RESIGNED		END STRENGTH 1986	RESIGNED		END STRENGTH 1987	RESIGNED	
		N	%		N	%		N	%		N	%
5	239	15	6.3	298	23	7.7	94	2	2.1	196	17	8.7
7	942	88	9.3	1,267	79	6.2	778	41	5.3	869	50	5.7
9	1,669	141	8.4	1,876	135	7.2	1,861	113	6.1	1,534	101	6.6
11	2,357	129	5.5	2,896	134	4.6	2,987	140	4.7	3,385	165	4.9
12	6,902	239	3.5	6,749	185	2.7	6,874	173	2.5	7,636	175	2.4
13	6,155	132	2.1	6,258	78	1.2	5,984	83	1.4	6,453	77	1.2
14	4,031	64	1.6	4,145	52	1.3	4,265	41	1.0	4,603	32	0.7
15	1,686	22	1.3	1,731	19	1.1	1,711	14	0.8	1,841	16	0.9
16	392	12	3.1	406	8	2.0	436	2	0.5	449	12	2.7
ALL	24,373	842	3.5	25,626	713	2.8	24,990	609	2.4	26,966	655	2.4

[a] CALENDAR YEARS. SOURCE: DMDC.

JM:kg-2
6/2/89

CHART V-8. 1981-87 RETIREMENTS BY GRADE LEVEL[a]

GRADE, GS	1981			1982			1983			1984		
	END STRENGTH 1980	RETIRED		END STRENGTH 1981	RETIRED		END STRENGTH 1982	RETIRED		END STRENGTH 1983	RETIRED	
		N	%		N	%		N	%		N	%
5	117	0	0	138	0	0	187	1	0.5	287	0	0
7	501	0	0	543	0	0	633	0	0	980	0	0
9	890	3	0.3	957	1	0.1	1,083	1	0.1	1,345	3	0.2
11	1,935	13	0.7	1,931	15	0.8	2,017	23	1.1	2,134	11	0.5
12	7,640	77	1.0	7,229	55	0.8	7,297	76	1.0	7,100	113	1.6
13	5,382	100	1.9	6,022	74	1.2	6,175	139	2.3	6,206	150	2.4
14	2,787	43	1.5	3,318	62	1.9	3,370	83	2.5	3,801	92	2.4
15	1,392	40	2.9	1,619	27	1.7	1,453	37	2.5	1,636	43	2.6
16	11	1	9.1	31	2	6.5	171	3	1.8	71	1	1.4
ALL	20,655	277	1.3	21,788	236	1.1	22,386	363	1.6	23,560	413	1.8

[a] CALENDAR YEARS. SOURCE: DMDC.

JM:kg-3
6/2/89

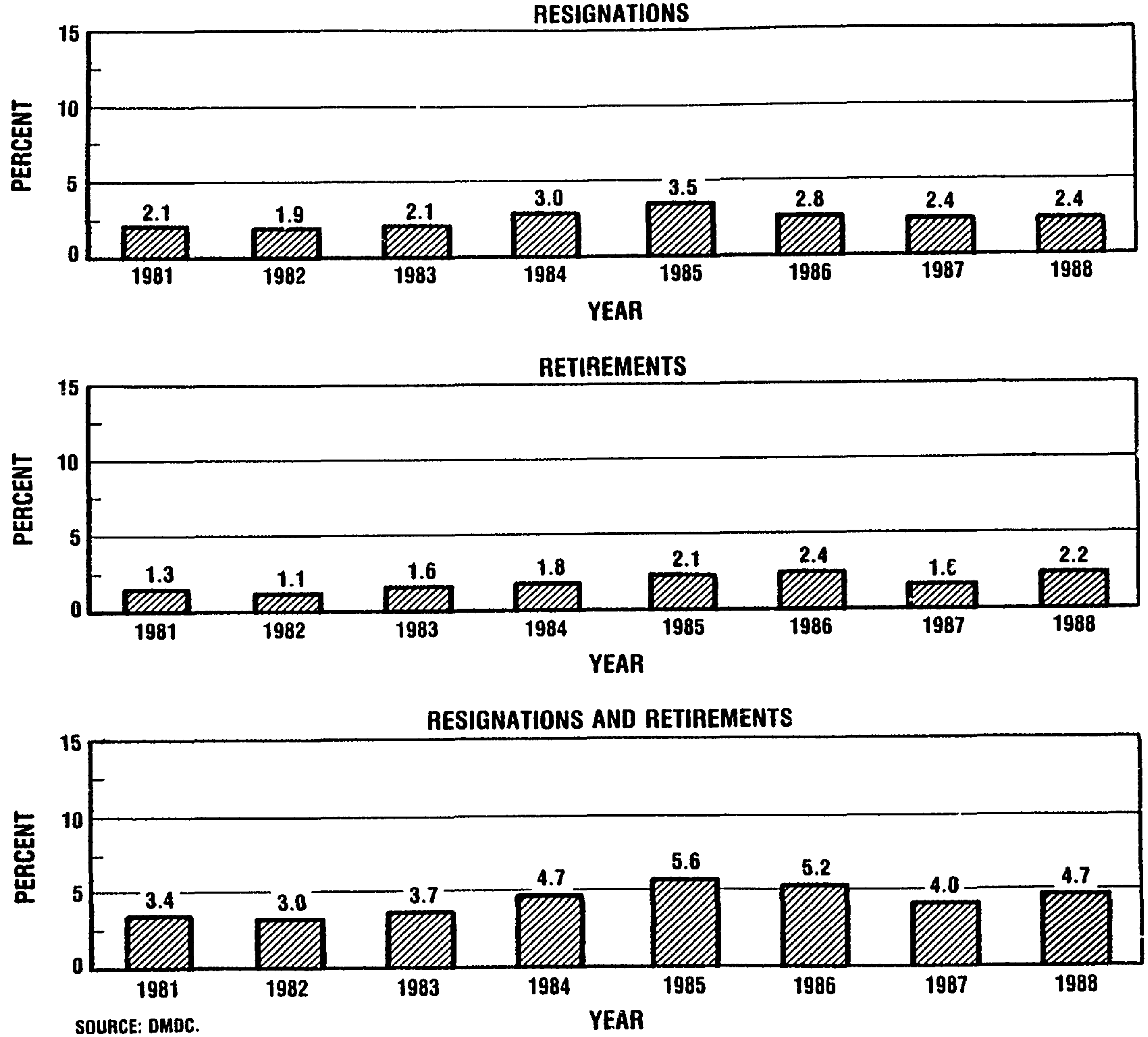
CHART V-8. 1981-87 RETIREMENTS BY GRADE LEVEL[a] (Continued)

GRADE, GS	1985			1986			1987			1988		
	END STRENGTH 1984	RETIRED		END STRENGTH 1985	RETIRED		END STRENGTH 1986	RETIRED		END STRENGTH 1987	RETIRED	
		N	%		N	%		N	%		N	%
5	239	0	0	298	0	0	94	0	0	196	0	0
7	942	1	0.1	1,267	1	0.1	778	0	0	869	0	0
9	1,669	2	0.1	1,876	1	0.1	1,861	0	0	1,534	2	0.1
11	2,357	12	0.5	2,896	26	0.9	2,987	6	0.2	3,385	13	0.4
12	6,902	111	1.6	6,749	120	1.8	6,874	77	1.1	7,636	129	1.7
13	6,155	157	2.6	6,258	167	2.7	5,984	130	2.2	6,453	185	2.9
14	4,031	140	3.5	4,145	184	4.4	4,265	110	2.6	4,603	165	3.6
15	1,686	78	4.6	1,731	86	5.0	1,711	61	3.6	1,841	89	4.8
16	392	13	3.3	406	31	7.6	436	16	3.7	449	18	4.0
ALL	24,373	514	2.1	25,626	616	2.4	24,990	400	1.6	26,966	601	2.2

[a] CALENDAR YEARS. SOURCE: DMDC.

JM:kg-4
6/2/89

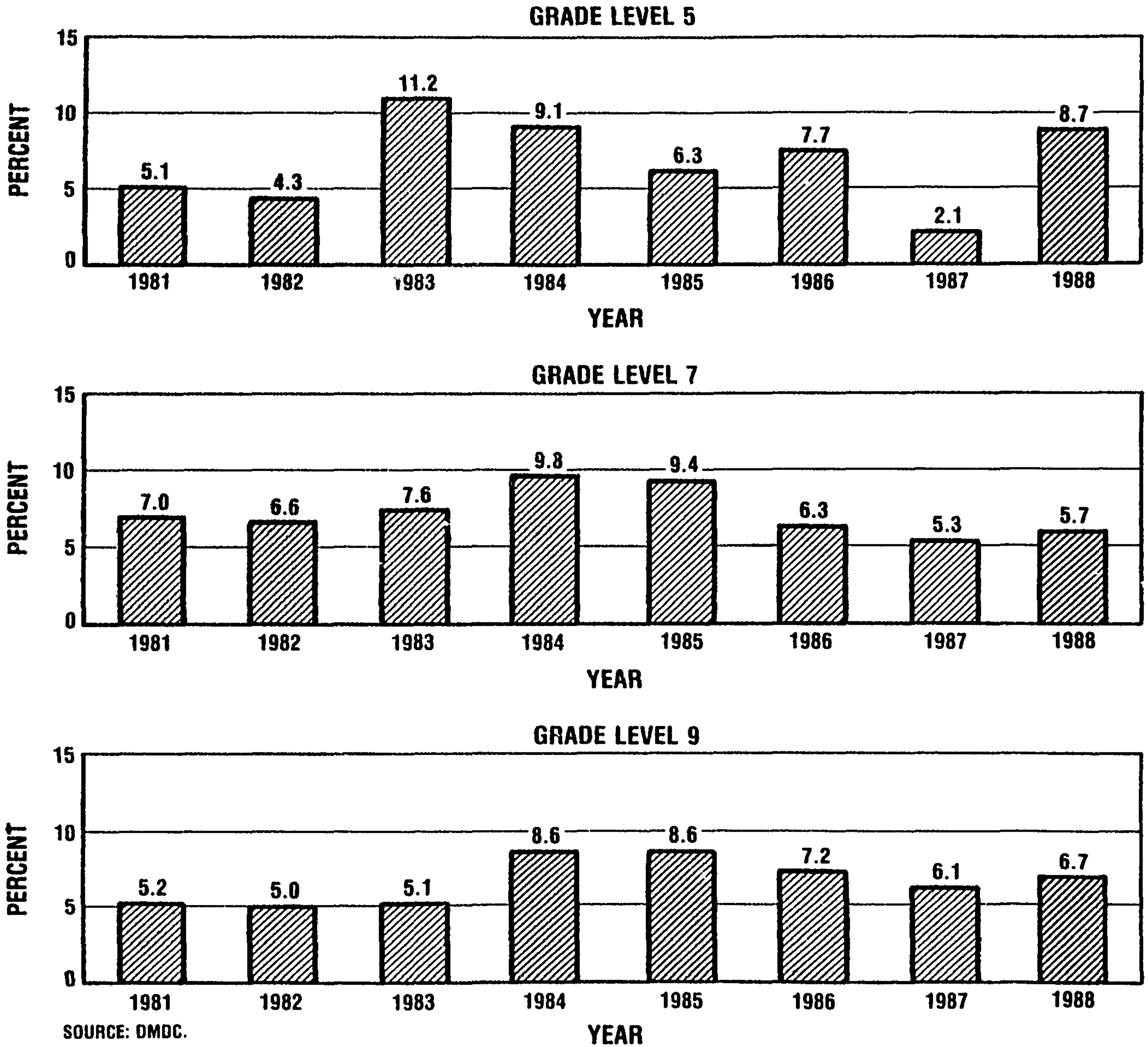
CHART V-9. RESIGNATIONS AND RETIREMENTS IN ALL GRADE LEVELS DURING CALENDAR YEARS 1981-87 (PERCENT OF YEAR-END STRENGTH)



SOURCE: DMDC.

3-21-89-2

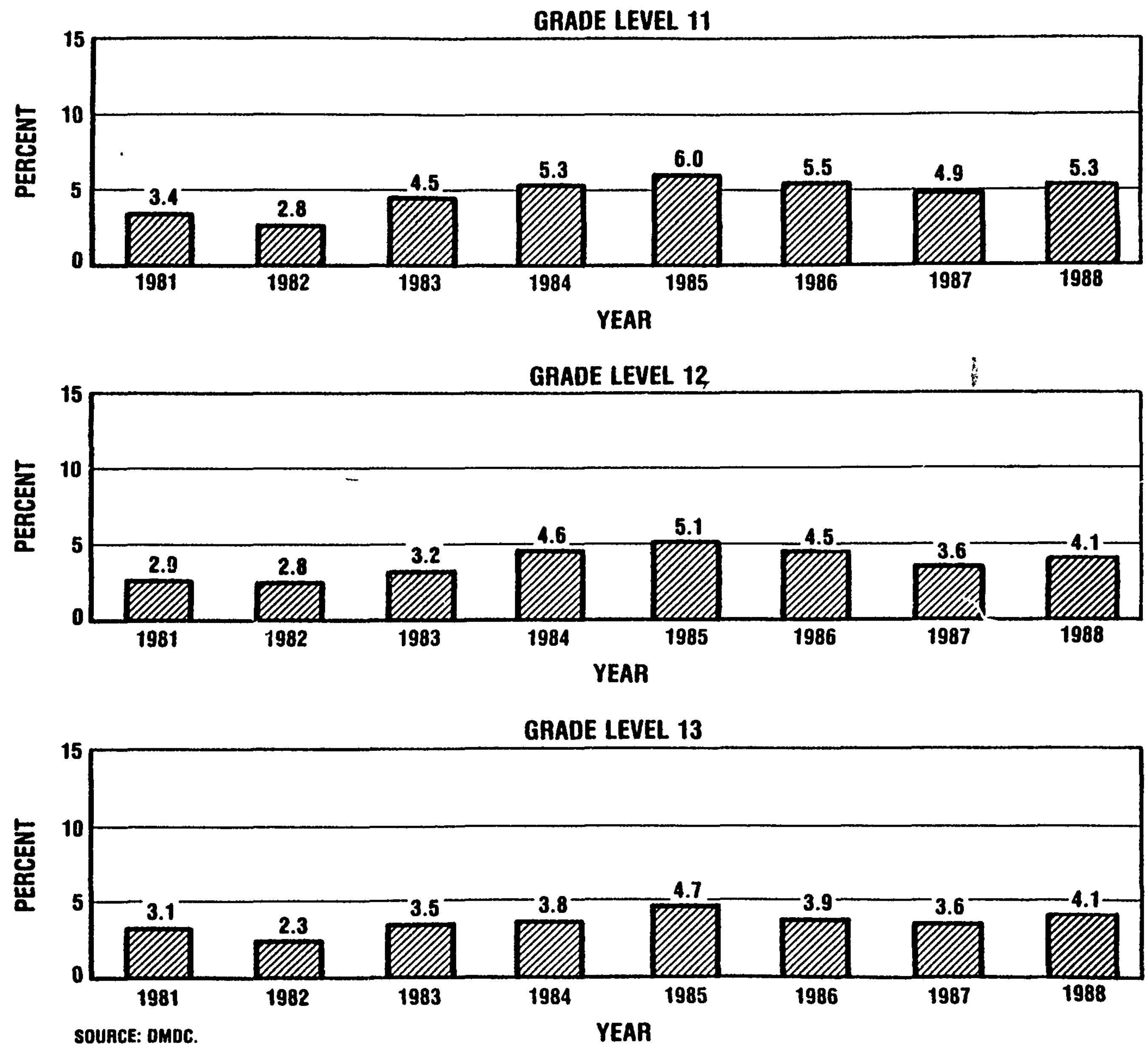
CHART V-10. RESIGNATIONS AND RETIREMENTS IN GRADE LEVELS 5, 7, AND 9 DURING CALENDAR YEARS 1981-87 (PERCENT OF YEAR-END STRENGTH)



SOURCE: DMDC.

3-21-89-3

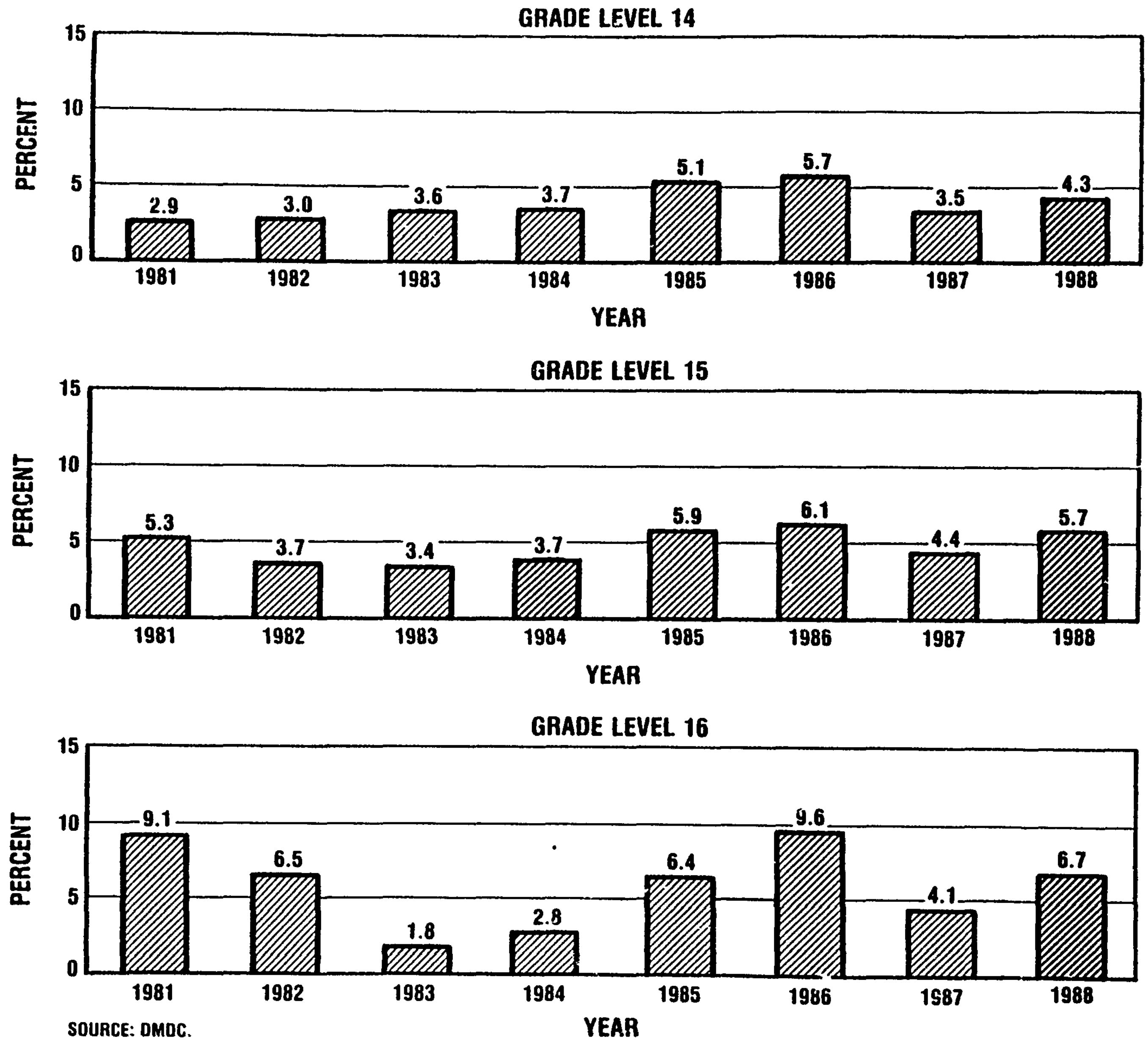
CHART V-II. RESIGNATIONS AND RETIREMENTS IN GRADE LEVELS 11, 12, AND 13 DURING CALENDAR YEARS 1981-87 (PERCENT OF YEAR-END STRENGTH)



SOURCE: DMDC.

3-21-89-4

CHART V-12. RESIGNATIONS AND RETIREMENTS IN GRADE LEVELS 14, 15, AND 16 DURING CALENDAR YEARS 1981-87 (PERCENT OF YEAR-END STRENGTH)



SOURCE: DMDC.

3-21-89-5

CHART V-13. S&E REASONS FOR STAYING[a]

REASON[b]	ARMY	NAVY	AIR FORCE	ALL LABS
TYPE OF WORK	7.4	7.7	8.0	7.6
USE OF SKILLS	6.5	6.6	7.2	6.7
JOB SECURITY	6.4	7.2	6.4	6.6
REPUTATION OF LABORATORY	6.1	6.5	7.3	6.4
UP-TO-DATE EQUIPMENT	6.0	6.2	7.4	6.3
LOCATION OF EMPLOYMENT	5.6	7.0	6.2	6.1
OPPORTUNITY FOR CONTINUED EDUCATION	5.5	5.3	5.9	5.5
TRAINING OPPORTUNITIES	5.1	5.5	5.5	5.3
OPPORTUNITY FOR ADVANCEMENT	5.4	4.7	5.8	5.3
MODERN FACILITIES	5.6	5.7	7.3	5.1
SALARY	5.1	4.7	5.6	5.0
PROXIMITY TO UNIVERSITIES	4.5	4.4	5.1	4.6
LACK OF OTHER OFFERS	4.4	5.2	4.5	4.6
COST OF LIVING IN LOCALITY	4.6	3.8	5.5	4.5
AFFORDABLE HOUSING NEARBY	4.1	3.6	5.1	4.1
PROXIMITY TO COMPETING INDUSTRY/ GOVERNMENT	3.0	3.4	4.0	3.3
REPUTATION OF CIVIL SERVICE	2.9	2.5	3.5	2.9
FACILITY NEAR TRANSPORTATION	2.8	1.6	1.5	2.2

[a] SOURCE: SURVEY QUESTION 21. AVERAGE RATINGS BASED ON A SCALE OF 0, NOT IMPORTANT, TO 9, VERY IMPORTANT, ARE SHOWN.

[b] AS STATED IN SURVEY QUESTIONNAIRE.

JM:kg-32
11/9/88

CHART V-14. REASONS FOR CIVILIAN S&E RESIGNATIONS[a]

REASON[b]	ARMY	NAVY	AIR FORCE	ALL LABS
SALARY	6.8	7.8	8.1	7.3
OPPORTUNITY FOR ADVANCEMENT	6.0	7.2	6.4	6.4
USE OF SKILLS	4.1	4.6	5.8	4.6
REPUTATION OF CIVIL SERVICE	4.7	3.9	5.3	4.6
COST OF LIVING IN LOCALITY	4.2	3.9	4.7	4.2
PROXIMITY TO COMPETING INDUSTRY/ GOVERNMENT	3.9	5.2	4.0	4.2
AFFORDABLE HOUSING NEARBY	3.9	3.9	4.5	4.0
TYPE OF WORK	3.8	3.4	5.2	3.9
LOCATION OF EMPLOYMENT	3.6	3.5	4.4	3.7
MODERN FACILITIES	3.0	2.7	4.6	3.2
OPPORTUNITY FOR CONTINUED EDUCATION	2.7	4.5	5.6	3.0
UP-TO-DATE EQUIPMENT	2.6	2.6	4.3	2.9
TRAINING OPPORTUNITIES	2.6	2.1	4.3	2.8
PROXIMITY TO UNIVERSITIES	2.3	2.3	5.2	2.8
REPUTATION OF LABORATORY	2.3	1.6	4.7	2.6
JOB SECURITY	2.0	1.9	3.7	2.3
FACILITY NEAR TRANSPORTATION	2.3	1.1	2.2	2.0

[a] SOURCE: SURVEY. AVERAGE RATINGS BASED ON A SCALE OF 0, NOT IMPORTANT, TO 9, VERY IMPORTANT, ARE SHOWN.
[b] AS STATED IN SURVEY QUESTION 21.

JM:kg-30
11/9/88

CHART V-15. REASONS FOR RESIGNATION BY GRADE DURING 1986

REASON FOR RESIGNATION	< GS 12		GS 12		> GS 12		MILITARY	
	ARAL[a]	ROSR[b]	ARAL	ROSR	ARAL	ROSR	ARAL	ROSR
TYPE OF WORK	3.1	7	3.0	7	3.4	7	3.6	6
OPPORTUNITY FOR ADVANCEMENT ELSEWHERE[c]	5.5	3	6.4	2-3	6.3	3	5.6	1
LACK OF OPPORTUNITY FOR LAB ADVANCEMENT	3.7	6	5.0	4	6.2	4	4.3	4
LOCATION OF EMPLOYMENT	2.8	8	2.6	8-9	2.7	9	3.1	7
SALARY INCREASE[c]	7.2	1	7.2	1	8.5	1	4.6	3
PERCEIVED REDUCTION IN FEDERAL BENEFITS	4.1	4	4.6	5-6	5.1	5	2.2	10
OPPORTUNITY FOR CONTINUED EDUCATION	1.9	10	1.6	10	1.6	10-11	2.9	8
LACK OF APPROPRIATE CLERICAL/TECHNICAL SUPPORT	2.4	9	2.6	8-9	3.0	8	2.4	9
JOB SECURITY	1.8	11	1.5	11	1.6	10-11	1.9	11
BETTER TOTAL COMPENSATION PACKAGE[c]	6.2	2	6.4	2-3	6.8	2	5.0	2
TIME SPENT IN NON-ENGINEERING/ NON-SCIENTIFIC DUTIES	3.9	5	4.6	5-6	4.9	6	3.8	5
OTHER	2.7		3.0		3.2		7.7	

[a] SOURCE: SURVEY QUESTION 17. AVERAGE RATING FOR ALL LABS BASED ON A SCALE OF 0, NOT INFLUENTIAL, TO 9, VERY INFLUENTIAL, ARE SHOWN.
[b] RANK ORDER OF SPECIFIC REASON.
[c] THREE MOST INFLUENTIAL REASONS.

JM:kg-31
11/9/88

CHART V-16. CIVILIAN S&E PROMOTIONS

GS GRADE LEVEL	NUMBER ELIGIBLE		PERCENT PROMOTED	
	1981	1986	1981	1986
9	803		61.0	
		1,663		60.9
11	1,741		31.0	
		2,630		39.8
12	7,069		7.4	
		6,318		10.9
13	5,731		5.4	
		5,990		8.2
14	2,897		5.0	
		3,856		5.4
15	1,178		1.6	
		1,578		2.3

SOURCE: 1981 DATA FROM REF. 1; 1986 DATA FROM DMDC.

JM:kg-33
11/9/88

CHART V-17. SUPERVISORY AND NON-SUPERVISORY HIGH-GRADE S&E, 1986

GRADE LEVEL	NUMBER OF SUPERVISORS				NUMBER AND PERCENT OF NON-SUPERVISORS							
	ARMY	NAVY	AIR FORCE	TOTAL	ARMY		NAVY		AIR FORCE		TOTAL	
GS/GM 13	200	478	176	854	1,891	90%	3,688	89%	906	84%	6,485	88%
GS/GM 14	630	809	278	1,717	595	49	921	53	324	53	1,840	52
GS/GM 15	476	519	191	1,186	125	21	328	39	79	29	532	30
PL/GS 16-18	0	5	0	5	0	0	5	50	2	100	7	58
SES	66	70	33	169	10	13	3	4	2	6	15	8
TOTALS[a]	1,372	1,881	678	3,931	2,621	66	4,945	72	1,313	66	8,879	69

[a] SOURCE: SURVEY QUESTION 14. SOME INCONSISTENT INPUTS--ALL LABS DID NOT ANSWER ALL QUESTIONS--TO SURVEY QUESTIONS ABOUT (1) GRADE DISTRIBUTION AND (2) SUPERVISORY STRENGTH MAKE THE TOTAL HIGH-GRADE STRENGTH OF 3,931 + 8,879 = 12,810, HIGHER BY 1,073 THAN THE HIGH-GRADE STRENGTH SHOWN EARLIER IN CHART II-23.

JM:kg-34
11/9/88

CHART V-18. POLICIES FOR PROMOTING S&E TO HIGH GRADES WITHOUT SUPERVISORY RESPONSIBILITIES[a]

POLICY[b]	ARMY		NAVY		AIR FORCE		ALL LABS	
	N	%	N	%	N	%	N	%
TECHNICAL EXPERTISE/MAN-IN-JOB QUALIFICATIONS	12	25	9	32	4	25	25	27
FOLLOW GOVERNMENT GUIDELINES/ PANEL REVIEW	11	22	5	18	3	19	19	20
NEED ABILITY TO PROMOTE TO HIGH GRADE SCIENTIFIC POST	6	12	2	7	3	19	11	12
DUAL CAREER RECOGNIZED & SUPPORTED	5	10	3	11	3	19	11	12
GS 13 - NO PROBLEM	5	10	3	11	0	0	8	9
GS 14 - EXPERT/CASE-BY-CASE	5	10	1	3	0	0	6	6
ALL HIGH GRADES ARE SUPERVISORS	2	4	3	11	1	6	6	6
OPPORTUNITIES ARE LIMITED	2	4	1	3	2	12	5	5
EXCELLENT FOR RETENTION	1	2	1	3	0	0	2	2

[a] SOURCE: SURVEY QUESTION 15. NUMBER OF RESPONSES (N) EXCEEDS NUMBER OF LABS DUE TO ADOPTION OF MULTIPLE PROMOTION POLICIES; PERCENTAGES MIGHT NOT TOTAL 100 BECAUSE OF ROUNDING.
[b] SEVERAL LAB RESPONSES CONVEY ATTITUDES VIS-A-VIS POLICIES.

JM:kg-35
11/9/88

CHART V-19. RATING THE SERIOUSNESS OF PERSONNEL PROBLEMS[a]

PROBLEMS AND CAUSES[b]	ARMY	NAVY	AF	TOTAL
RECRUITMENT OF S&E	100%	90%	88%	91%
SALARY LIMITATIONS	7.8	7.2	8.3	7.7
AUTHORIZATIONS CEILINGS	7.3	6.3	7.5	7.0
LIMITED HIGH GRADES	5.1	6.2	7.3	5.9
BUREAUCRATIC CONSTRAINTS	5.8	5.4	7.1	5.6
FINDING PEOPLE WITH APPROPRIATE SKILLS	4.7	6.2	5.9	5.4
RETENTION OF S&E	85%	95%	100%	91%
SALARY LIMITATIONS	7.5	7.2	7.7	7.5
LIMITED HIGH GRADES	6.0	5.6	7.2	6.1
BUREAUCRATIC CONSTRAINTS	4.5	5.4	7.3	5.3
INABILITY TO HIRE EXPERIENCED PEOPLE	82%	79%	100%	84%
SALARY LIMITATIONS	6.5	6.8	7.8	6.9
LIMITED HIGH GRADES	5.3	5.7	8.0	5.9
BUREAUCRATIC CONSTRAINTS	4.8	4.6	7.2	5.2
AUTHORIZATION CEILINGS	5.3	3.5	5.6	4.8
FINDING PEOPLE WITH APPROPRIATE SKILLS	4.2	5.3	3.7	4.4
LOW S&E MORALE	82%	65%	91%	78%
SALARY LIMITATIONS	6.7	6.2	7.4	6.7
BUREAUCRATIC CONSTRAINTS	6.1	5.4	7.9	6.2
LIMITED HIGH GRADES	5.1	5.0	6.7	5.3

[a] SOURCE: SURVEY QUESTION 28. AVERAGE RATINGS BASED ON A SCALE OF 0, NOT SERIOUS, TO 9, VERY SERIOUS, ARE SHOWN; PERCENTAGES INDICATE PORTION OF LABS THAT RATED A PROBLEM AS SERIOUS (7, 8, OR 9).

[b] ONLY CAUSES RATED 4.0 OR GREATER ARE LISTED.

JM:kg-36
11/9/88

CHART V-20. RATING THE SERIOUSNESS OF WORK-RELATED PROBLEMS[a]

PROBLEMS AND CAUSES[b]	ARMY	NAVY	AF	TOTAL
INADEQUATE MANNING LEVELS	82%	79%	100%	84%
AUTHORIZATION CEILINGS	6.7	5.7	6.8	6.4
LIMITED HIGH GRADES	3.8	3.7	7.3	4.4
BUREAUCRATIC CONSTRAINTS	3.4	4.1	6.6	4.2
LOSS OF SPECIFIC TECHNICAL CAPABILITIES	76%	65%	73%	72%
SALARY LIMITATIONS	5.5	5.9	6.5	5.8
AUTHORIZATION CEILINGS	5.5	3.8	5.0	4.9
LIMITED HIGH GRADES	3.6	4.3	6.6	4.4
BUREAUCRATIC CONSTRAINTS	3.5	4.1	6.2	4.1
UNABLE TO RESPOND TO REQUESTS FOR WORK	64%	53%	91%	65%
AUTHORIZATION CEILINGS	5.6	5.2	6.6	5.6
BUREAUCRATIC CONSTRAINTS	3.4	3.9	6.6	4.1
INCREASED CONTRACTING OUT	64%	47%	91%	63%
AUTHORIZATION CEILINGS	6.0	4.9	6.0	5.7
BUREAUCRATIC CONSTRAINTS	3.9	3.5	6.0	4.1
UNABLE TO RESPOND TO UNPROGRAMMED REQUESTS	61%	53%	73%	61%
AUTHORIZATION CEILINGS	5.3	4.5	5.9	5.1
BUREAUCRATIC CONSTRAINTS	3.6	3.9	6.6	4.3

[a] SOURCE: SURVEY QUESTION 28. AVERAGE RATINGS BASED ON A SCALE OF 0, NOT SERIOUS, TO 9, VERY SERIOUS, ARE SHOWN; PERCENTAGES INDICATE PORTION OF LABS THAT RATED A PROBLEM AS SERIOUS (7, 8, OR 9).
[b] ONLY CAUSES RATED 4.0 OR GREATER ARE LISTED.

JM:kg:37
11/9/88

CHART V-21. RATING THE SERIOUSNESS OF THE IMPACT OF AUTHORIZATION CEILINGS[a]

IMPACT	ARMY		NAVY[b]		AIR FORCE		TOTAL	
	%	$\overline{S}$	%	$\overline{S}$	%	$\overline{S}$	%	$\overline{S}$
HINDERS S&E RECRUITMENT	73	7.3	55	6.3	82	7.5	69	7.0
INADEQUATE MANNING LEVELS	64	6.7	53	5.7	82	6.8	63	6.4
INCREASED CONTRACTING OUT	48	6.0	32	4.9	64	6.0	46	5.7
UNABLE TO RESPOND TO REQUEST FOR WORK	42	5.6	42	5.2	64	6.6	46	5.6
INCREASED S&E WORKLOAD	61	5.9	35	4.4	64	6.6	53	5.5
CANNOT SATISFY CUSTOMER DEMAND	45	5.7	30	4.3	73	7.0	44	5.5
REDUCTION OF IN-HOUSE EXPERTISE	55	5.8	35	3.6	64	6.2	50	5.2
INCREASED USE OF TEMPORARIES	61	6.3	21	3.3	55	5.1	48	5.2
UNABLE TO RESPOND TO UNPROGRAMMED REQUESTS	45	5.3	32	4.5	55	5.9	43	5.1
INABILITY TO HIRE EXPERIENCED PEOPLE	52	5.3	32	3.5	64	5.6	48	4.8

[a] SOURCE: SURVEY QUESTION 28. AVERAGE SERIOUSNESS-OF-IMPACT RATINGS ($\overline{S}$) BASED ON A SCALE OF 0, NOT SERIOUS, TO 9, VERY SERIOUS, ARE SHOWN; PERCENTAGES INDICATE PORTION OF LABS THAT RATED A PROBLEM AS SERIOUS (7, 8, OR 9).

[b] CONSIDERED "BUDGET CEILINGS" RATHER THAN "AUTHORIZATION CEILINGS" BECAUSE OF MANAGE-TO-BUDGET OPERATING SYSTEM.

JM:kg-38
11/9/88

CHART V-22. RATING THE SERIOUSNESS OF THE IMPACTS OF LIMITED HIGH-GRADE POSITIONS (GS 13-15)[a]

IMPACT	ARMY		NAVY		AIR FORCE		TOTAL	
	%	$\bar{S}$	%	$\bar{S}$	%	$\bar{S}$	%	$\bar{S}$
INABILITY TO PROMOTE DESERVING PEOPLE	58	5.7	40	5.8	91	8.0	58	6.1
HINDERS S&E RETENTION	52	6.0	55	5.6	73	7.2	56	6.1
INABILITY TO HIRE EXPERIENCED PEOPLE	52	5.3	48	5.7	91	8.0	57	5.9
RECRUITMENT OF S&E	39	5.1	55	6.2	73	7.3	50	5.9
LOW S&E MORALE	39	5.1	40	5.0	73	6.7	45	5.3
REDUCTION OF IN-HOUSE EXPERTISE	58	5.1	30	4.5	73	6.7	44	5.2

[a] SOURCE: SURVEY QUESTION 28. AVERAGE SERIOUSNESS-OF-IMPACT RATINGS ($\bar{S}$) BASED ON A SCALE OF 0, NOT SERIOUS, TO 9, VERY SERIOUS, ARE SHOWN; PERCENTAGES INDICATE PORTION OF LABS THAT RATED IMPACT AS SERIOUS (7, 8, OR 9).

JM:kg-39
11/9/88

CHART V-23. RATING THE SERIOUSNESS OF IMPACT OF BUREAUCRATIC CONSTRAINTS[a]

IMPACT	ARMY		NAVY		AIR FORCE		TOTAL	
	%	$\bar{S}$	%	$\bar{S}$	%	$\bar{S}$	%	$\bar{S}$
LOW S&E MORALE	61	6.1	55	5.4	82	7.9	63	6.2
HINDERS S&E RECRUITMENT	49	5.8	50	5.4	73	7.1	53	5.6
INABILITY TO PROMOTE DESERVING PEOPLE	42	5.1	50	5.5	91	7.1	53	5.6
RETENTION OF S&E	24	4.5	45	5.4	64	7.3	38	5.3
INABILITY TO HIRE EXPERIENCED PEOPLE	39	4.8	40	4.6	82	7.2	48	5.2
REDUCTION OF IN-HOUSE EXPERTISE	39	4.8	40	4.2	73	6.9	45	5.0
WORK DELAYS	36	4.3	26	5.1	73	6.7	40	5.0

[a] SOURCE: SURVEY QUESTION 28. AVERAGE SERIOUSNESS-OF-IMPACT RATINGS ($\bar{S}$) BASED ON A SCALE OF 0, NOT SERIOUS, TO 9, VERY SERIOUS, ARE SHOWN; PERCENTAGES INDICATE PORTION OF LABS THAT RATED IMPACT AS SERIOUS (7, 8, OR 9).

JM:kg-40
11/9/88

CHART V-24. LABORATORY DIRECTORS' IDENTIFICATION, IN PERCENTAGES, OF PROBLEMS AND CONSEQUENCES THAT IMPACT THEIR ABILITY TO RESOLVE S&E ISSUES

SERVICE	NO. OF LABS	NO. OF S&E[a]	WT.[b]	PROBLEMS: LOW SALARIES AND BENEFITS	PROBLEMS: MANPOWER CONSTRAINTS[c]	PROBLEMS: CENTRALIZED MANAGEMENT[d]	PROBLEMS: HIGH-GRADE LIMIT[e]	PROBLEMS: PERFORMANCE APPRAISAL SYSTEM[f]	CONSEQUENCES: RECRUITMENT DIFFICULT	CONSEQUENCES: RETENTION DIFFICULT	CONSEQUENCES: LOWER QUALITY OF PERSONNEL
ARMY	35	8,301	1 PER LAB	25	19	12	16	3	9	8	7
			NO. OF S&E	6,379	5,876	2,217	4,813	1,170	2,173	2,008	1,524
NAVY	20	13,652	1 PER LAB	15	7	10	5	0	8	6	3
			NO. OF S&E	13,151	8,005	9,490	5,044	0	7,101	5,049	3,944
AIR FORCE	11	3,031	1 PER LAB	6	6	5	6	6	5	2	2
			NO. OF S&E	2,193	2,213	2,244	1,975	2,057	745	1,544	1,521
TOTAL	66	24,984	1 PER LAB	46	32	27	27	9	22	16	12
			NO. OF S&E	21,723	16,094	13,951	11,832	3,227	10,019	8,601	6,989
			% OF S&E	87	65	56	48	13	40	35	28

[a] IN CASE OF SUBSTANTIAL DIFFERENCE IN DMDC AND SURVEY INPUTS OF A LAB'S S&E POPULATION, THE SOURCE MOST CONSISTENT WITH POPULATIONS IN PRIOR YEAR WAS USED.
[b] WEIGHT GIVEN TO DIRECTORS' INPUTS FROM SURVEY QUESTION 41.
[c] NEED MORE PEOPLE; PERSONNEL CUTS AND HIRING FREEZES HURT; MANAGING TO PAYROLL OR BUDGET NOT RELATED TO WORKLOAD.
[d] TOO INFLEXIBLE AND SLOW TO RESPOND.
[e] TOO FEW HIGH GRADE POSITIONS; LACK OF PROMOTION AVAILABILITY.
[f] RESTRICTIVE RULES ON MONETARY AWARDS.

JM:kg-41
11/9/88

CHART V-25. LABORATORY DIRECTORS' ASSESSMENT, IN PERCENTAGES, OF S&E STATUS, CONCERNS, OR ISSUES

SERVICE	NUMBER OF LABS	NUMBER OF S&E[a]	WEIGHT	MOST-DISCUSSED PROBLEMS[b]					
				AUTHORIZATION CEILINGS[c]		PERSONNEL PRACTICES[d]		BUDGET UNCERTAINTY	
ARMY	35	8,301	1 PER LAB	10		7		5	
			NO. OF S&E		3,110		1,624		982
NAVY	20	13,652	1 PER LAB	5		5		6	
			NO. OF S&E		6,100		4,836		1,731
AIR FORCE	11	3,031	1 PER LAB	3		5		2	
			NO. OF S&E		900		2,221		1,859
TOTAL	66	24,984	1 PER LAB	18		17		13	
			NO. OF S&E		10,110		8,861		2,713
			% OF S&E		41		35		11

[a] IN CASE OF SUBSTANTIAL DIFFERENCE IN DMDC AND SURVEY INPUTS OF A LAB'S S&E POPULATION, THE SOURCE MOST CONSISTENT WITH POPULATIONS IN PRIOR YEARS WAS USED.
[b] THAT HAMPER LOCAL LABORATORY MANAGEMENT. SOURCE: SURVEY QUESTION 42.
[c] CAUSE TECHNICAL WORK TO BE CONTRACTED OUT.
[d] SUCH AS ESTABLISHING BILLETS, CLASSIFYING POSITIONS, PROMOTING PERSONNEL, AND NEGOTIATING SALARIES, ALL OF WHICH INVOLVE DISTANT AND DELAYED DECISIONMAKING BY CENTRALIZED MANAGEMENT.

JM:kg-42
11/9/88

VI. TRAINING

VI. TRAINING

Chart VI-1 indicates that most of the labs' S&E participated in short-term training programs. Less than 10 percent took part in training programs that were longer than one month.

Chart VI-2 indicates that virtually all S&E attend scientific and skills training.

Chart VI-3 indicates that nearly all labs utilize or encourage the three types of training activities--viz., academic courses, symposia and conferences, and participation in professional S&E societies--listed in the survey questionnaire. Over half of the labs felt that academic courses should be emphasized for training.

About two-thirds of the labs (42 of 66) have arrangements with educational institutions to provide graduate and post-graduate technical education. Chart VI-4 indicates that most arrangements (37 of 42) provide for academic credit to be given upon course completion and that the labs share the cost--25 labs pay over 90 percent--of the training.

When asked whether the existing prohibition against paying the cost of training for the sole or principal purpose of obtaining an academic degree poses a problem, Chart VI-5 indicates that 26 labs said yes. Most of these labs thought that the prohibition hindered recruitment and retention. However, most labs (59 of 66) think the cost-sharing problem is not serious enough that training needed to maintain S&E currency is affected.

Chart VI-6 shows that the major difficulty in providing S&E training is work load demands on time.

CHART VI-1. LAB PERCENTAGE OF S&E PARTICIPATION IN TRAINING IN GOVERNMENT-SPONSORED PROGRAMS DURING 1986

PROGRAM LENGTH	ARMY	NAVY	AF	TOTAL
CIVILIAN				
LESS THAN A WEEK	44.1	61.6	50.5	50.2
1-4 WEEKS	35.0	48.6	28.9	37.8
1-6 MONTHS	3.5	9.1	9.6	6.2
6+ MONTHS	1.1	3.1	1.7	1.8
MILITARY				
LESS THAN A WEEK	31.9	42.1	53.7	39.5
1-4 WEEKS	26.2	28.1	28.5	27.2
1-6 MONTHS	0.7	9.6	7.5	4.6
6+ MONTHS	1.4	2.5	3.3	2.1

SOURCE: SURVEY QUESTION 29.

JM:kg-64
11/11/88

CHART VI-2. PERCENTAGE OF S&E TRAINING BY TYPES AND SITES OVER PAST THREE YEARS[a]

TYPES OF TRAINING	LESS THAN A WEEK	1-4 WEEKS	1-6 MONTHS	6+ MONTHS	TOTALS
SCIENTIFIC & SKILLS	44.6	36.7	14.2	3.1	98.6
MANAGEMENT	22.9	12.9	2.4	1.1	39.3
EXECUTIVE DEVELOPMENT	13.7	7.7	1.6	0.2	23.2
SUPERVISORY	18.9	11.6	1.2	0.0	31.7
OTHER[b]	28.2	1.1	0.1	0.5	29.9
TRAINING SITES					
IN-HOUSE	35.9	16.3	6.5	2.1	60.8
UNIVERSITY	12.3	20.6	16.7	14.2	63.8
CONTRACT	26.3	23.4	4.6	2.1	56.4
OTHER GOVERNMENT	15.6	14.7	6.2	5.2	41.7
OTHER[c]	30.0	23.7	1.7	0.8	56.2

[a] SOURCE: SURVEY QUESTION 30.
[b] SAFETY, ORIENTATION, ADMINISTRATION, DRUG AND ALCOHOL, EQUAL EMPLOYMENT OPPORTUNITY, PRE-RETIREMENT, AND SOFTWARE.
[c] PRIVATE INDUSTRY, SYMPOSIA, AND SELF STUDY.

JM:kg-65
11/11/88

CHART VI-3. TRAINING ACTIVITIES TO KEEP S&E CURRENT[a]

ACTIVITY	NUMBER AND PERCENTAGE OF LABS AT WHICH TRAINING ACTIVITY: IS AVAILABLE OR ENCOURAGED		NEEDS MORE EMPHASIS	
	NUMBER	PERCENT	NUMBER	PERCENT
ACADEMIC COURSES	65		37	
		98		56
SYMPOSIA AND CONFERENCES	66		21	
		100		32
PARTICIPATION IN PROFESSIONAL S&E SOCIETIES	64		18	
		97		27
OTHER[b]	34		15	
		52		23

[a] SOURCE: SURVEY QUESTION 37 AND 38.
[b] 27 LABS USE NON-ACADEMIC SHORT COURSES.

JM:kg-66
11/11/88

CHART VI-4. S&E TRAINING ARRANGEMENTS WITH EDUCATIONAL INSTITUTIONS

ARRANGEMENT	NUMBER OF LABS
EDUCATIONAL INSTITUTIONS PROVIDE GRADUATE AND POST-GRADUATE TECHNICAL EDUCATION	42
ABOVE INSTITUTIONS CONVEY ACADEMIC CREDIT UPON COMPLETION OF EACH COURSE	37
LABS ACCEPT SOME COST SHARING	
100% COST PAID BY LAB	14
91-99% COST PAID BY LAB	11
76-90% COST PAID BY LAB	3
51-75% COST PAID BY LAB	6
≤ 50% COST PAID BY LAB	3

SOURCE: SURVEY QUESTIONS 31, 32, AND 33.

JM:kg-1
6/5/89

CHART VI-5. LAB VIEWS ON SHARING COSTS OF TRAINING

LAB VIEW	NUMBER OF LABS
PROHIBITION AGAINST PAYING THE COST OF TRAINING SOLELY TO OBTAIN AN ACADEMIC DEGREE POSES A PROBLEM	26
THIS PROHIBITION CITED AS A PROBLEM IN SEVERAL CONTEXTS:	
RECRUITMENT	18
RETENTION	22
GREIVANCES	3
OTHER	5
THIS PROHIBITION, HOWEVER, IS NOT AN OBSTACLE TO PROVIDE TRAINING NECESSARY TO KEEP S&E CURRENT	59

SOURCE: SURVEY QUESTIONS 34 AND 35.

JM:kg-2
6/5/89

CHART VI-6. DIFFICULTIES IN PROVIDING TRAINING FOR LAB S&E

DIFFICULTY	NUMBER[a]	PERCENT[b]
INADEQUATE FUNDING	6	9.2
TRAINING POLICIES	5	7.7
ADMINISTRATIVE TRAINING PROCEDURES	0	0.0
LACK OF TRAINING SOURCES	3	4.6
INSUFFICIENT TIME[c]	27	41.5
INADEQUATE MANAGERIAL SUPPORT	1	1.5
S&E INTEREST	3	4.6
OTHER	2	3.1
NO SIGNIFICANT PROBLEMS	18	27.7

[a] SOURCE: SURVEY QUESTION 36. ONE OF 66 LABS DID NOT PROVIDE DATA.
[b] BECAUSE OF ROUNDING, TOTAL = 99.9.
[c] DUE TO WORK LOAD OR OTHER DEMANDS.

JM:kg-69
11/11/88

VII. SENIOR EXECUTIVE SERVICE

VII. SENIOR EXECUTIVE SERVICE

Chart VII-1 indicates that the number of senior executives--GS 16-18, Public Law 313, and SES--has grown about nine percent (195 to 213) from 1981 to 1986 and that vacancies are substantially reduced (down from 58 to 18).

Charts VII-2, -3, and -4 reflect lab director responses to a survey question that asked "How is the SES system working?" While their responses, like those to the open-ended questions on S&E discussed earlier (Section V and Charts V-24 and V-25), are very inciteful individually, we have also developed a statistical sense of their comments. A dual-scoring approach weights each lab (1) equally and (2) in proportion to its SES population when directors addressed themes that were most common among their narrative responses.

Chart VII-2 indicates that there is no strong consensus either to applaud or to damn the SES system.

Chart VII-3 indicates that, by either weighting system, few lab directors evaluate the SES rotation system as good. Most of their evaluations are distributed among defects--viz., unrecognized need for technical knowledge in high-level positions and financial burden--and consequences--viz., not implemented significantly nor used effectively and positions not filled by qualified people.

Chart VII-4 shows directors' evaluation of SES pay. Here again, by either weighting scheme, few directors (less than 10 percent) think that salaries or bonuses are good enough. One half of the directors say that the pay is too low and is not competitive with industry, and one half say that bonuses are too small.

CHART VII-1. SENIOR EXECUTIVES

ON-BOARD DISTRIBUTION BY TYPE

YEAR	GS 16-18	PL 313	SES	TOTAL
1981	12	6	177	195
1986[a]	6	10	197	213

DISTRIBUTION BY SERVICE

PERSONNEL PARAMETER	ARMY		NAVY		AIR FORCE		ALL LABS	
	1981	1986	1981	1986	1981	1986	1981	1986
SENIOR EXECUTIVE POSITIONS AS PERCENTAGE OF ALL S&E	1.0		1.1		1.0		1.1	
		0.8		0.8		1.4		0.8
VACANCIES, NUMBER	24		16		18		58	
		2		0		16		18
VACANCIES, PERCENTAGE	28		13		42		23	
		3		0		30		8

[a] ALL DATA IN THIS ROW ARE FROM DMDC; ALL OTHER 1986 DATA IN THE CHART ARE FROM THE SURVEY; ALL 1981 DATA ARE FROM THE FIRST DoD LAB S&E STUDY (REF. 1).

JM:kg-70
11/11/88

CHART VII-2. LAB DIRECTORS' OVERALL EVALUATION OF SES SYSTEM

SERVICE	NUMBER OF LABS WITH AT LEAST 1 SES[a]	NUMBER OF SES	WEIGHT	EVALUATION							
				GOOD		FAIR		POOR		NO COMMENT	
ARMY	21 (35)	65	1 PER LAB	6		3		5		7	
			NO. OF SES		15		15		12		23
NAVY	13 (20)	91	1 PER LAB	4		1		0		8	
			NO. OF SES		28		3		0		60
AIR FORCE	10 (11)	41	1 PER LAB	2		2		1		5	
			NO. OF SES		3		13		2		23
TOTAL	44 (66)	197	1 PER LAB	12		6		6		20	
			NO. OF SES		46		31		14		106

[a] TOTAL NUMBER OF LABS IN PARENTHESES

JM:kg-71
11/11/88

CHART VII-3. LABORATORY DIRECTORS' EVALUATION OF SES ROTATION SYSTEM[a]

SERVICE	NUMBER OF LABS WITH AT LEAST 1 SES[b]	NUMBER OF SES	WEIGHT	GOOD		EVALUATION: MAJOR DEFECTS: HIGH-LEVEL TECHNICAL KNOWLEDGE NEEDED[c]		EVALUATION: MAJOR DEFECTS: FINANCIAL BURDEN		EVALUATION: CONSEQUENCES: NOT IMPLEMENTED SIGNIFICANTLY		EVALUATION: CONSEQUENCES: NOT USED EFFECTIVELY		EVALUATION: CONSEQUENCES: OTHER[d]	
ARMY	21 (35)	65	1 PER LAB	2		4		5		4		3		5	
			NO. OF SES		7		12		26		9		4		9
NAVY	13 (20)	91	1 PER LAB	2		5		2		0		3		4	
			NO. OF SES		12		49		18		0		20		37
AIR FORCE	10 (11)	41	1 PER LAB	0		0		0		4		0		0	
			NO. OF SES		0		0		0		21		0		0
TOTAL	44 (66)	197	1 PER LAB	4		9		7		8		6		9	
			NO. OF SES		19		61		44		30		24		46

[a] SOURCE: SURVEY QUESTION 40.
[b] TOTAL NUMBER OF LABS IN PARENTHESES.
[c] BUT OFTEN UNRECOGNIZED OUTSIDE THE LABS.
[d] DETERS FILLING POSITIONS WITH QUALIFIED PEOPLE; ENCOURAGES RETIREMENT; STIMULATES MOVEMENT TO INDUSTRY.

JM:kg-72
11/11/88

CHART VII-4. LABORATORY DIRECTORS' EVALUATION OF SES PAY[a]

SERVICE	NUMBER OF LABS WITH AT LEAST 1 SES[b]	NUMBER OF SES	WEIGHT	EVALUATION									
				SALARY									
				GOOD ENOUGH		TOO LOW,[c] NCWI		GOOD ENOUGH		TOO SMALL		AWARD SYSTEM DEFECTIVE[d]	
ARMY	21 (35)	65	1 PER LAB	1		9		3		7		10	
			NO. OF SES		2		37		7		25		25
NAVY	13 (20)	91	1 PER LAB	1		8		0		5		1	
			NO. OF SES		10		61		0		51		3
AIR FORCE	10 (11)	41	1 PER LAB	2		0		1		3		2	
			NO. OF SES		2		0		5		23		9
TOTAL	44 (66)	197	1 PER LAB	4		17		4		15		13	
			NO. OF SES		14		98		12		99		37

[a] SOURCE: SURVEY QUESTION 40.
[b] TOTAL NUMBER OF LABS IN PARENTHESES.
[c] NOT COMPETITIVE WITH INDUSTRY.
[d] AWARDS INFLUENCED BY SUPERVISORS' WRITING SKILLS AT LEAST AS MUCH AS BY SUBJECTS' PERFORMANCE; AWARDS BIASED IN FAVOR OF THOSE IN HIGH-VISIBILITY POSITIONS.

JM:kg-73
11/11/88

VIII. PAY

VIII. PAY

Pay comparisons were made using DMDC salary data for lab S&E and survey data from seven different organizations--viz., the National Science Foundation (NSF), the U.S. Bureau of Labor Statistics (BLS), the American Institute of Physics (AIP), the Institute of Electrical and Electronics Engineers (IEEE), the National Society of Professional Engineers (NSPE), the U.S. Department of Energy (DoE), and the Engineering Manpower Commission (EMC). Four of the surveys--NSF, BLS, DoE and EMC--used questionnaires to ask organizations that employ S&E for pay data, which participants provide from payroll records of their S&E. In the other three surveys, AIP, IEEE, and NSPE poll their members individually by questionnaire.

The AIP, IEEE, and NSPE understandably do not make checks to validate members' responses. The absence of validity checks of pay data creates a concern about the suitability of professional society pay standards for evaluating the pay of DoD lab S&E. We believe that any population solicited individually to provide income data to other than governmental tax agencies will include those who, when filling out a survey form, are not careful about definition details pertaining to elements that should or should not be counted as income; do not recall specific income figures; do not retrieve pay stubs, tax returns, or other records to refresh their memories; and thus make rounded-up estimates in minimum time-and-energy responses.

Another concern is the uncertainty that professional society memberships are representative of counterpart S&E populations of the labs. We frankly do not know. We do know, however, that on the basis of education, the lab S&E population is very representative of NSF's national S&E population. Chart II-23 showed that the proportions of both populations with bachelor's, master's, and doctor's degrees could not be much closer. Chart II-23 also showed that the percentage distribution of lab S&E is less representative of a 1984 national S&E population, whose distribution of employed S&E by level of highest degree was prepared by the University of Michigan's Survey Research Center and presented in a recent National Academy of Sciences report concerning S&E (Ref. 8).

Before reviewing our seven pay-comparability analyses, Charts VIII-1 and -2 display the GS salary rates for 1986 and 1981, respectively.

A. NATIONAL SCIENCE FOUNDATION SURVEYS

Chart VIII-3 compares the pay of DoD lab S&E with salaries of S&E nationwide--in business and industry, educational institutions, nonprofit organizations, the Federal Government, and the military. Both populations include S&E of assorted age, education, and experience. The 1986 NSF data indicate that the national scientist earns an average $5K less than his lab counterpart while the national engineer earns about $1K more than the lab engineer.

Chart VIII-4 compares average 1986 salaries of two groups--*viz.*, (1) business and industry and (2) Federal Government, which includes the DoD labs--from the latest NSF survey. Here we see that Federal Government scientists are ahead of scientists in business and industry by about $3K, while Federal Government engineers are on average a few hundred dollars behind engineers in business and industry.

B. BUREAU OF LABOR STATISTICS SURVEYS

Salary comparisons with national S&E in the NSF surveys are circumscribed by the insensitivity of the latter to education, experience, or any other measure of S&E quality. Here we compare the salaries of lab engineers distributed by grade level in the labs with salaries of BLS-surveyed engineers at levels of responsibility that are equivalent to Federal GS grade levels.

Job definitions for various occupations and work levels are jointly prepared by the BLS and the Office of Personnel Management (OPM). These definitions are designed to describe, for employees in the private sector, duties and responsibilities that are comparable to General Schedule (GS) occupations and grade levels. The job definitions for BLSs wage surveys provide guidelines for BLS field staff in classifying into appropriate occupations, or work levels within occupations, private-sector-workers who are employed under a variety of payroll titles and different work arrangements from establishment to establishment and from area to area. Thus, occupational wage rates representing comparable job content are grouped. Federal GS grade levels, as defined by public law, are models the BLS and OPM use for definitions of work levels within occupations.

Chart VIII-5 shows that lab engineers went from a $4K pay superiority in 1981 to $2K pay inferiority in 1986. However, Chart VIII-5 also shows that lab engineers at any grade level are paid substantially less in 1986 than national engineers at equivalent levels of responsibility: $9K less for GS-5; $8K less for GS-7; $7K less for GS-9; $9K less for GS-11; $14K less for GS-12 and -13; $16K less for GS-14; and $18K less for GS-15. Charts VIII-6 and VIII-7 show the input data and calculations of salaries in Chart VIII-5.

In Chart VIII-8, a plot of the distributions of lab and national populations of engineers by grade level, or corresponding level of responsibility, shows that faster early-career promotions for lab engineers, whose 1986 median grade is GS 11.8 explains why they are on average only $2K behind the national engineers, whose equivalent 1986 grade is 9.5.

C. AMERICAN INSTITUTE OF PHYSICS SURVEY

While the BLS data relate pay to level of responsibility, neither the BLS data nor the NSF data are related to other surrogates of S&E quality--viz., age, years of experience, and education level. And neither data base gives percentile salaries; thus we are constrained to compare average salaries and are unable to compare the salaries of high-value S&E in the labs with their national high-percentile counterparts.

Before discussing the AIP data, which are related to education level, we show in Charts VIII-9 and VIII-10, mean and percentile salaries of Ph.D. physicists (job code 1310) in the labs as a function of time since receiving doctor's degree. The 1986 salaries in these two charts were then compared to salaries of Ph.D. members of the AIP, an umbrella organization that includes the following ten societies: (1) The American Physical Society, (2) Optical Society of America, (3) Acoustical Society of America, (4) The Society of Rheology, (5) American Association of Physics Teachers, (6) American Crystallographic Association, (7) American Astronomical Society, (8) American Association of Physicists in Medicine, (9) American Vacuum Society, and (10) American Geophysical Union. In its 1986 membership survey, 6,356 respondents of AIP (whose membership is 89,000) identified themselves in the following categories: 58 percent physicist, 16 percent engineer, nine percent chemist, five percent astronomer, seven percent other scientist, and five percent other. Of the 3,829 respondents who indicated their predominant fields, 774 Ph.D.s were in physics and astronomy (Ref. 17). (For convenience, we will call the AIP members "physicists.")

Chart VIII-9 shows that mean salary increases for physicists in year groups 5-9, 20-24, and more-than-24 matched or slightly exceeded (by 1 or 2 percent) the 21-percent inflation that consumer price indexes indicate the U.S. experienced in the five-year period; mean salaries of physicists in other year groups did not keep pace with inflation. The 1986 weighted average salary is barely more than $49,009, the 1981 weighted average salary increased by 21 percent to match five years' inflation.

It is interesting to note in Chart VIII-9 that the labs increased their Ph.D. physicists population by 25 percent in the five year period, 1981-1986, while the national population of Ph.D. physicists/astronomers grew by 14 percent (from unpublished data of the National Academy of Sciences).

Chart VIII-11 shows that DoD lab physicists are $9K to $15K behind AIP members whatever the time lapse since doctorate award. A comparison of standard deviations shows a much wider range of salaries for AIP members in all "years-since-receiving-doctorate" strata.

Chart VIII-12 compares median and 90th percentile salaries of Ph.D. physicists in the DoD labs and physicists in the national labs (which are DOE-administered) and in industry as a function of time lapse since doctorate. We see that throughout their careers DoD lab physicists earn median salaries that are about $10K less than those of physicists in industry and that range from $2K to $8K below those of national lab physicists. For the 90th percentile physicist in the DoD labs, his early-career salary is about $10K less than the counterpart salary in industry and by the time 20 years have passed, he or she is earning $30K less. Compared to the counterpart salary in the national labs, his or her salary varies from $7K to $10K less over the first 20 years, and, because of the Federal pay cap, the salary is $20K less by the 25-year mark.

Charts VIII-13 and -14 graphically compare 1986 percentile salaries of Ph.D. physicists in the DoD labs with percentile salaries in industry (Chart VIII-13) and in the national labs (Chart VIII-14). These charts show 10th, 25th, and 75th percentile salaries in addition to 50th and 90th percentile salaries already shown in Chart VIII-12.

D. INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS SURVEY

The IEEE sent a survey questionnaire to every fifth person in its 157,453 membership in January 1987. The survey report is based on questionnaires returned by 12,679 members. In its survey report (Ref. 18), the IEEE provides statistics on income, which includes salary, commissions, and bonuses, but excludes overtime pay, supplemental pay, and retirement benefits.

Charts VIII-15 through -20 compare 1986 salaries of DoD lab EEs with salaries of IEEE members, most of whom are EEs, by level of responsibility (the system also used by BLS), by age, by years of experience, and by education level.

Chart VIII-15 shows that IEEE salaries are above DoD lab salaries at all grade levels. Across the grade levels, IEEE mean salaries range from $7K to $23K higher and IEEE median salaries range from $6K to $14K higher. A comparison of standard deviations shows that there is a much wider range of salaries for IEEE members for all levels of responsibility (or equivalent grade levels).

Chart VIII-16 shows that IEEE mean salary superiority is about $10K across the GS 9-15 grade levels for EEs with 15 to 20 years experience.

Charts VIII-17 and -18 show similarly that IEEE salaries are several thousands of dollars superior to lab salaries for all age groups of EEs. Chart VIII-17 shows that, across the age groups, IEEE mean salaries range from $6K to $20K higher and IEEE median salaries range from $5K to $13K higher. Chart VIII-18 shows that for EEs with 15 to 20 years experience, IEEE mean salaries range from $12K to $16K higher for those under 60 years of age; for those over 60, the IEEE mean salary is about $6K higher.

Chart VIII-19 shows that when we consider years of experience, mean and median salaries of IEEE members are substantially above lab EE salaries across the board. Mean salaries for IEEE are $5K better than for the labs when EEs have less than two-years' experience and grow to $17K better after 25 years. Median salaries for IEEE range from $2K to $16K better across the years-of-experience spectrum.

And Chart VIII-20 shows that, at all education levels, mean salaries favor IEEE members; those with advanced degrees earn $17K more than do lab EEs with master's and doctor's degrees.

E. NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS SURVEY

The NSPE mailed its salary survey questionnaire in January 1987 to its 61,620 members. The NSPE survey report is based on questionnaires returned by 15,240 members.

In its survey report (Ref. 19), NSPE "income" includes the member's annual base salary as of 1 January 1987 plus additional cash income from his or her primary job--fees, bonuses, and commission--but not overtime pay or income from secondary or part-time employment during the preceding year.

Chart VIII-21 indicates that 1986 salaries of all engineers by level of responsibility (or grade level) favor NSPE members by $5K or more at all levels.

Charts VIII-22 and -23 show that NSPE median salaries are a few thousand dollars better at all levels of responsibility until the Federal pay cap puts lab engineers in GS 16-18 grade levels at a $20K disadvantage. Ninety-percentile NSPE salary superiority grows from $15K at the GS 5-7 level to $20K for GS-13s, and because of the pay cap, the superiority grows even more for higher-level engineers.

Charts VIII-24, -25, and -26 show NSPE salaries to be similarly greater than lab-engineer salaries when related to length of service. The mean salary in the labs starts $2K below that of NSPE engineers with one year of experience and drops to $18K below for engineers with 30 years of experience. While pay comparability exists for 10th and 25th percentile engineers in the two groups, lab pay inferiority becomes progressively worse as we look at increasing service lengths and at higher percentile salaries.

Chart VIII-27 compares mean salaries of engineers in three different branches, viz., civil, mechanical, and EE. In each branch, the lab engineer's pay is more than $1000 per month less than the pay of his or her NSPE counterpart.

Charts VIII-28, -29, and -30 show that, in terms of percentile salaries, the NSPE members are favored across the board--and the differences grow with higher percentiles--whether they are civil engineers, mechanical engineers, or EEs.

And, finally, Chart VIII-31 compares the 1986 salaries of all lab engineers by education level with those of NSPE members. Here we find that mean salaries of lab engineers range $14K to $21K below those of NSPE members while lab median salaries are worse by $8K to $13K over all education levels.

F. DEPARTMENT OF ENERGY SURVEYS

The U.S. Department of Energy sponsors surveys that relate annual salary to elapsed time (years) since S&E received their bachelor's degrees. The DoE surveys should be of particular interest to DoD officials whose concerns involve pay comparability of DoD lab S&E. The DoE surveys cover R&D activities in industry, nonprofit research institutes, educational institutions, Contract Research Centers, and Federal laboratories. The annually-collected data enable DoE to relate salaries to S&E distributed by (1) education level--less than bachelor's degree, bachelor's, master's, and doctor's; (2) by field--chemistry, physics, EE, mechanical engineering, etc.; (3) by supervisory level--middle management, unit head, assistant unit head, and nonsupervisory; and (4) by employment region--Northeast, Southeast, Midwest, Northwest, and Southwest.

Chart VIII-32 compares salaries of lab S&E--in all 89 job codes listed in Chart I-1--with bachelor's degrees only with national S&E at the same education level from DoE surveys of 1981 and 1986. In 1981, the average pay of the two S&E populations was very nearly equal for any elapsed time since baccalaureate award. The average-salary comparison favored lab S&E by about $2K in 1981. But in 1986 the comparison favors the national S&E by about $3K; 1986 salaries favor national S&E by $2K to $5K across all categories of the elapsed-time spectrum.

If DMDC, whose file records include highest education level and year of highest-degree award, would add a single data element, viz., year of bachelor's degree, for S&E with advanced degrees, the annually-renewed DoE data base would be entirely useful to DoD. With the inclusion of the baccalaureate-date element, DMDC files could provide data for all variables used by DoE for pay-comparability analysis. Another attraction of the DoE data base is the availability of percentile salaries.

For our immediate analysis of pay comparability, we assumed that DoD lab S&E with advanced degrees had received their bachelor's degrees when they were 22 years old, and then we compared the distribution of CY 1987 salaries of all lab S&E to corresponding salaries of national S&E in the DoE survey of 1987. Selection of 22 years for baccalaureate age was based on our survey of DoD-wide S&E in 1988. We found that 4,914 of 15,130 respondents had either a doctor's degree or a master's degree. About 28 percent of the 4,914 received their bachelor's degree before they were 22 years old; 34 percent were 22 when they received their baccalaureate; 14 percent were 23; and 24 percent were 24 or older. The mean age and median age are 23.02 years and 22 years, respectively.

Charts VIII-33, -34, and -35 compare CY 1987 salaries of nonsupervisory S&E in the DoD labs and in industrial R&D establishments in the 1987 DoE survey for bachelor's-, master's-, and doctor's-degree level of education, respectively. Salaries are shown as a function of maturity, which is defined as number of years since receipt of baccalaureate. These charts indicate that the CY 1987 distribution of 21,071-degreed lab S&E by education level was 62-percent bachelor's degree, 25-percent master's, and 13-percent doctor's. The sample population, which numbered 21,273, of industrial S&E in DoE's survey, included 54-percent bachelor's degrees, 25-percent master's, and 20-percent doctor's.

Average salaries weighted by maturity (Charts VIII-33, -34, and -35) are more easily compared for the three education levels in Chart VIII-36. This chart and the preceding tabulations indicate that average salaries favor industrial S&E by about $3.5K, $4.5K, and $7K at the bachelor's-, master's-, and doctor's-degree levels, respectively.

Average percentile salaries weighted by maturity are also compared for the three education levels in a single chart, Chart VIII-37, which includes 10-percentile and 25-percentile salaries that are not included in tabulations in Charts VIII-33, -34, and -35. Chart VIII-37 shows that differences in average percentile-salary between the DoD labs and Industry are larger for higher education levels and for higher percentile S&E. We see, for example, that 90-percentile S&E in Industry make $7K more than their lab counterparts at the bachelor's-degree level, $8K more at the master's-degree level, and $11K more at the doctor's-degree level.

In the next 20 charts, in four five-chart sets, we look at four occupations--chemists, physicists, electrical and electronics engineers (EEs), and mechanical engineers--in the same way we looked at all S&E occupations combined in Charts VIII-33 through -37. The four occupation groups are drawn from all sectors--Industry, Federal Government, Contract Research Centers, Nonprofit Establishments, and Educational Institutions--of the DOE survey, whereas the DOE salary data in Charts VIII-33 through -37 pertain to S&E in Industry only. Although salary differences vary, we see in the next 20 charts that average- and percentile-salary differences similarly favor industrial S&E in each occupation.

Charts VIII-38, -39, and -40 indicate that the proportions of chemists with master's and doctor's degrees is the same--18 percent and 43 percent, respectively--for the 879 chemists in the DoD labs and for DoE's industrial sample of 4,213 chemists (percentage distributions are calculated by dividing the DoD and DoE populations shown in each chart by the aggregate populations in the three charts). These tabulations plus bar charts, Charts VIII-41 and -42 that follow, show average salaries favoring industrial chemists by about $1.5K, $2.5K and $5K at the bachelor's-, master's-, and doctor's-degree levels, respectively. Differences in average percentile salaries are generally similar to those for all S&E combined; however, Chart VIII-42 shows that high-percentile salaries in Industry are as much as $10K above lab salaries while low-percentile salaries are about $3K less for 10- and 25- percentile industrial chemists.

Charts VIII-43, -44, and -45 indicate that the CY 1987 distribution of 2,042-degreed lab physicists by education level was 35 percent bachelor's, 27 percent master's, and 39 percent doctor's degrees. The DoE sample population of 2,324 physicists in Industry ran 27 percent, 23 percent, and 50 percent at those degree levels, respectively. Charts VIII-46 and -47 show that differences in average- and percentile-salaries of physicists to be generally similar to those already shown in Charts VIII-36 and -37 for all S&E combined.

Charts VIII-48, -49, and -50 indicate that 71 percent of 5,989 lab EEs are at the bachelor's-degree level versus 58 percent of 8,384 EEs in the industrial sector surveyed by DoE, 25 percent hold master's degrees versus 32 percent in Industry, and four percent hold doctorates versus 10 percent in Industry. Charts VIII-51 and -52 show that differences in average- and percentile-salaries of EEs are similar to differences for all S&E.

Charts VIII-53, -54, and -55 show that the CY 1987 distribution of 3,219-degreed lab mechanical engineers by education level is 76-percent bachelor's-, 20-percent master's-, and four-percent doctor's degrees. Mechanical engineers in DoE's Industry survey are divided 59 percent, 28 percent, and 12 percent among the bachelor's-, master's-, and doctor's-degree levels, respectively. Charts VIII-56 and -57 indicate that average- and percentile-salary differences for mechanical engineers are similar to those for chemists, physicists, and EEs and to all S&E combined.

Salaries of supervisory S&E in DoE's survey are not related to maturity nor to education level. However, average and percentile salaries are available for First Line Supervisors and for Division Directors in Charts VIII-58 and -59, respectively.

In Chart VIII-58, lab S&E are assumed to have supervisory responsibilities equivalent to First Line Supervisors if they are GS-12, -13, or -14 and coded "Supervisor" in DMDC's files or are classified GM-13 or -14. This tabulation shows that average salary favors First Line Supervisors in Industry by about $6K, and the average for all sectors, including Industry, is slightly higher. At low percentile (10 and 25) salaries, we find pay comparability between First Line Supervisors in the labs and those in Industry or in all sectors. But as we consider 50-, 75-, and 90-percentile salaries, we see pay differences growing from about $5K to $11K in favor of Industry.

In Chart VIII-59, we assume that DoD lab S&E who are GS-15, -16, -17, -18 or SES have supervisory responsibilities equivalent to Division Directors. This tabulation shows that average salary favors Division Directors in Industry or in all sectors combined by about $14K. Percentile-salary differences favoring Division Directors in Industry grow from about $13K at the 10th percentile to $20K at the 90th percentile.

G. ENGINEERING MANPOWER COMMISSION SURVEY

Much like the DoE, the EMC conducts annual surveys of engineers' salaries. The survey data enable us to relate average and percentile salaries of a large national sample of engineers to maturity, i.e., number of years since receipt of baccalaureate; and to education level. As we did in our pay comparability analyses using DoE data, we assumed that DoD lab engineers--in the 22 engineering job codes listed in Chart I-1--with advanced degrees received their bachelor's degrees at age 22.

With salary data from EMC's 1987 survey, we first consider nonsupervisory engineers in Charts VIII-60 through -64. Charts VIII-60, -61, and -62 indicate that the distribution of 13,666 nonsupervisory lab engineers by education level is 70 percent bachelor's degree, 25 percent master's degree, and five percent doctor's degree. Corresponding percentages of engineers in Industry are estimated, from EMC's sample of 77,524, to be 71 percent, 23 percent, and seven percent, respectively.

Chart VIII-63 indicates that average pay differences favor nonsupervisory engineers in Industry by about $1.5K, $2K, and $6K at the bachelor's-, master's-, and doctor's-degree levels, respectively.

Chart VIII-64 indicates that differences in percentile salaries are less than $3K in favor of Industry at the bachelor's- and master's-degree levels. For nonsupervisory engineers with doctorates, the differences favor Industry by $5K to $8K.

Charts VIII-65 through -69 compare CY 1987 salaries of supervisory lab engineers--i.e., all engineers classified as "Supervisory" or "Managerial" in the DMDC files--to salaries of supervisory engineers in EMC's 1987 survey. Charts VIII-65, -66, and -67 indicate that the distribution of 2,099 supervisory lab engineers by education level is 53 percent bachelor's, 37 percent master's, and 10 percent doctor's degree. The EMC sample of 28,203 supervisory engineers in Industry has 64 percent bachelor's, 29 percent master's, and eight percent doctor's degrees.

Chart VIII-68 shows that average pay differences favor supervisory engineers in Industry by about $1K, $7K, and $10K at the bachelor's-, master's-, and doctor's-degree levels.

Chart VIII-69 indicates that low-percentile-salary differences at the bachelor's-degree level favor the DoD labs. Higher-percentile-salary differences at that education level favor Industry. At the advanced-degree levels, salaries are better in Industry for all percentiles, and salary differences grow more favorable to Industry as we look at higher percentiles. In Industry, supervisory engineers with master's degrees at the 90-percentile are paid $13K more than their counterparts in the labs; with doctorates, the 90-percentile supervisors in Industry have an $18K-salary advantage.

CHART VIII-1. GENERAL SCHEDULE SALARY RATES FOR 1986

LONGEVITY STEPS	1	2	3	4	5	6	7	8	9	10
1	$9,339	$9,650	$9,961	$10,271	$10,582	$10,764	$11,071	$11,380	$11,393	$11,686
2	10,501	10,750	11,097	11,393	11,521	11,860	12,199	12,538	12,877	13,216
3	11,458	11,840	12,604	12,604	12,986	13,368	13,750	14,132	14,514	14,896
4	12,862	13,291	14,149	14,149	14,578	15,007	15,436	15,865	16,294	16,723
5	14,390	14,870	15,830	15,830	16,310	16,790	17,270	17,750	18,230	18,710
6	16,040	16,575	17,110	17,645	18,180	18,715	19,250	19,785	20,320	20,855
7	17,824	18,418	19,012	19,606	20,200	20,794	21,388	21,982	22,576	23,170
8	19,740	20,398	21,056	21,714	22,372	23,030	23,688	24,346	25,004	25,662
9	21,804	22,531	23,258	23,985	24,712	25,439	26,166	26,893	27,620	28,347
10	24,011	24,811	25,611	26,411	27,211	28,011	28,811	29,611	30,411	31,211
11	26,381	27,260	28,139	29,018	29,897	30,776	31,655	32,534	33,413	34,292
12	31,619	32,673	33,727	34,781	35,835	36,889	37,943	38,997	40,051	41,105
13[b]	37,599	38,852	40,105	41,358	42,611	43,864	45,117	46,370	47,623	48,876
14[b]	44,430	45,911	47,392	48,873	50,354	51,835	53,316	54,797	56,278	57,759
15[b]	52,262	54,004	55,746	57,488	59,230	60,972	62,714	64,456	66,198	67,940
16	61,296	63,339	65,382	67,425	69,468[a]	71,511[a]	73,554[a]	75,597[a]	77,640[a]	
17	71,804[a]	74,197[a]	76,590[a]	78,983[a]	81,376[a]					
18	84,157[a]									

[a] BASIC PAY IS LIMITED BY SECTION 5308 OF TITLE 5 OF THE UNITED STATES CODE TO THE RATE FOR LEVEL V OF THE EXECUTIVE SCHEDULE. LIMITED TO $68,000

[b] MERIT PAY FOR GS13/15 MANAGERS AND SUPERVISORS WILL BE A GM RATHER THAN GS DESIGNATION.

M:kg-43
1/9/88

CHART VIII-2. GENERAL SCHEDULE SALARY RATES FOR 1981

GS	GENERAL SCHEDULE 5 U.S.C. 5332(a)										AMT. OF STEP INCR.
	1	2	3	4	5	6	7	8	9	10	
1	$7,960	$8,225	$8,490	$8,755	$9,020	$9,175	$9,437	$9,699	$9,712	$9,954	Varied
2	8,951	9,163	9,459	9,712	9,820	10,109	10,398	10,687	10,976	11,265	Varied
3	9,766	10,092	10,418	10,744	11,070	11,396	11,722	12,048	12,374	12,700	$326
4	10,963	11,328	11,693	12,058	12,423	12,788	13,153	13,518	13,883	14,248	365
5	12,266	12,675	13,084	13,493	13,902	14,311	14,720	15,129	15,538	15,947	409
6	13,672	14,128	14,584	15,040	15,496	15,952	16,408	16,864	17,320	17,776	456
7	15,193	15,699	16,204	16,711	17,217	17,723	18,229	18,735	19,241	19,747	506
8	16,825	17,387	17,948	18,509	19,070	19,631	20,192	20,753	21,314	21,875	561
9	18,585	19,205	19,825	20,445	21,065	21,685	22,305	22,925	23,545	24,165	620
10	20,467	21,149	21,831	22,513	23,195	23,877	24,559	25,241	25,923	26,605	682
11	22,486	23,236	23,986	24,736	25,486	26,236	26,986	27,736	28,486	29,236	750
12	26,951	27,849	28,747	29,645	30,543	31,441	32,339	33,237	34,135	35,033	898
13	32,048	33,116	34,184	32,252	36,320	37,388	38,456	39,524	40,592	41,660	1068
14	37,871	39,133	40,395	41,657	42,919	44,181	45,443	46,705	47,967	49,229	1262
[a]15	44,547	46,032	47,517	49,002	50,487	51,972	53,457	54,942	56,427	57,912	1485
[a]16	52,247	53,989	55,731	57,473	59,215	60,957	62,699	64,441	66,183		1742
[a]17	61,204	63,244	65,284	67,324	69,364						2040
[a]18	71,734										

[a] NOTWITHSTANDING THE SALARY RATES SHOWN, THE RATE OF BASIC PAY LEGALLY PAYABLE (E.G., TO EMPLOYEES IN GRADES GS-15 THROUGH GS-18) MAY NOT EXCEED THE RATE PAYABLE FOR LEVEL V OF THE EXECUTIVE SCHEDULE, AS OF THE EFFECTIVE DATE OF THIS SCHEDULE $51,112.50 PER ANNUM.

JM:kg-44
11/9/88

CHART VIII-3. AVERAGE ANNUAL SALARIES OF S&E BY FIELD

SCIENTISTS	NATIONAL[a]		DoD LABS[b]	
	1981[c]	1986[d]	1981	1986
SOCIOLOGISTS AND ANTHROPOLOGISTS	22,908	27,000	31,071	37,373
PSYCHOLOGISTS	26,496	33,400	34,513	42,058
BIOLOGISTS	25,944	33,000	28,426	35,403
MEDICAL SCIENTISTS	35,788	41,100	49,771	60,378
PHYSICISTS & ASTRONOMERS	34,868	45,900	37,061	45,245
CHEMISTS	30,912	38,900	34,770	41,664
OCEANOGRAPHERS	32,752	39,600	34,443	42,712
MATHEMATICIANS	32,568	39,500	31,214	38,164
STATISTICIANS	30,176	41,600	27,710	33,457
COMPUTER SPECIALISTS	29,624	37,300	28,757	31,073
TOTAL SCIENTISTS	32,936	35,700	34,605	40,635

[a] SOURCE: NATIONAL SCIENCE FOUNDATION.
[b] SOURCE: DMDC FOR CORRESPONDING JOB CODES.
[c] FROM A 1982 NSF REPORT (REF. 11); NSF PUBLISHED NO SURVEY STATISTICS FOR 1981. SALARIES FOR 1982 HAVE BEEN MULTIPLIED BY 0.92, THE RATIO OF AVERAGE ENGINEER 1981/1982 SALARIES CALCULATED FROM U.S. BUREAU OF LABOR STATISTICS AVERAGE SALARY STATISTICS FOR 1981 (REF. 12) AND 1982 (REF. 13).
[d] FROM NSF (REF. 4).

JM:kg-45
11/8/88

CHART VIII-3. AVERAGE ANNUAL SALARIES OF S&E BY FIELD (Continued)

ENGINEERS	NATIONAL[a]		DoD LABS[b]	
	1981[c]	1986[d]	1981	1986
CIVIL	30,820	38,000	33,772	39,072
MECHANICAL	33,396	40,800	33,837	37,394
NUCLEAR	35,328	44,100	28,747[e]	34,328[f]
ELECTRICAL & ELECTRONICS	33,488	42,400	34,527	40,842
AERONAUTICS	35,420	43,800	36,595	43,205
CHEMICAL	36,064	43,700	32,200	36,875
INDUSTRIAL	30,084	37,900	31,311	34,933
TOTAL ENGINEERS	32,936	40,800	34,472	39,871
TOTAL S&E	34,000	38,400	34,519	39,126

[a] SOURCE: NATIONAL SCIENCE FOUNDATION.
[b] SOURCE: DMDC FOR CORRESPONDING JOB CODES.
[c] FROM A 1982 NSF REPORT (REF. 11); NSF PUBLISHED NO SURVEY STATISTICS FOR 1981. SALARIES FOR 1982 HAVE BEEN MULTIPLIED BY 0.92, THE RATIO OF AVERAGE ENGINEER 1981/1982 SALARIES CALCULATED FROM U.S. BUREAU OF LABOR STATISTICS AVERAGE SALARY STATISTICS FOR 1981 (REF. 12) AND 1982 (REF. 13).
[d] FROM NSF (REF. 4).
[e] POPULATION = 1.
[f] POPULATION = 7.

JM:kg-45a
11/8/88

CHART VIII-4. AVERAGE ANNUAL SALARIES OF SCIENTISTS AND ENGINEERS BY FIELD, 1986

SCIENTISTS	BUSINESS AND INDUSTRY	FEDERAL GOVERNMENT
CHEMISTS	39,800	41,300
PHYSICISTS & ASTRONOMERS	48,000	46,200
MATHEMATICIANS	40,900	44,500
STATISTICIANS	42,600	40,800
COMPUTER SPECIALISTS	37,900	38,600
EARTH SCIENTISTS	37,300	39,100
OCEANOGRAPHERS	38,900	37,500
ATMOSPHERIC SCIENTISTS	42,900	42,400
BIOLOGICAL SCIENTISTS	35,000	33,300
MEDICAL SCIENTISTS	41,800	45,300
PSYCHOLOGISTS	32,200	39,300
SOCIAL SCIENTISTS	28,700	40,700
SOCIOLOGISTS & ANTHROPOLOGISTS	21,800	28,400
TOTAL SCIENTISTS	36,000	39,000

SOURCE: NATIONAL SCIENCE FOUNDATION (REF. 4)

JM:kg-46
11/8/88

CHART VIII-4. AVERAGE ANNUAL SALARIES OF SCIENTISTS AND ENGINEERS BY FIELD, 1986 (Continued)

ENGINEERS	BUSINESS AND INDUSTRY	FEDERAL GOVERNMENT
AERONAUTICAL/ASTRONAUTICAL	44,200	43,200
CHEMICAL	43,800	43,300
CIVIL	38,800	38,700
ELECTRICAL/ELECTRONIC	42,800	41,300
INDUSTRIAL	38,000	38,300
MATERIALS	42,000	39,000
MECHANICAL	41,000	40,200
NUCLEAR	45,400	47,200
TOTAL ENGINEERS	41,200	40,500
TOTAL S&E	39,300	39,800

SOURCE: NATIONAL SCIENCE FOUNDATION (REF. 4)

JM:kg-46a
11/8/88

CHART VIII-5. AVERAGE ANNUAL SALARIES OF ENGINEERS

LEVEL OF RESPONSIBILITY OR GRADE LEVEL	NUMBER OF PEOPLE				NATIONAL[a]		DoD LABS[c]	
	NATIONAL[a]		DoD LABS[b]					
	1981	1986	1981	1986	1981	1986	1981	1986
1 / GS 5	28,233		84		21,712		15,947	
		40,469		71		27,866		18,710
2 / GS 7	48,312		336		23,663		19,747	
		71,336		602		31,194		23,170
3 / GS 9	108,063		527		26,746		24,165	
		145,165		1,150		35,715		28,347
4 / GS 11	134,180		1,019		31,352		28,861	
		157,033		1,738		42,677		33,853
5 / GS 12	97,379		4,441		36,725		31,531	
		111,913		4,133		50,769		36,467
6 / GS 13	45,433		3,622		42,622		38,456	
		52,105		3,414		58,883		44,491
7 / GS 14	14,450		1,741		49,287		44,686	
		13,395		2,038		68,602		52,427
8 / GS 15	2,785		674		56,828		52,269	
		3,097		807		79,021		61,320
TOTAL	478,835		12,444					
		594,513		13,953				

[a] FROM BUREAU OF LABOR STATISTICS (REFS. 12 AND 14).
[b] FROM DMDC.
[c] FROM DMDC AND 1986 AND 1981 ANNUAL SALARY RATES, REFS. 15 AND 16, WHICH ARE SHOWN IN CHARTS VIII-1 AND VIII-2, RESPECTIVELY.

JM:kg-47
11/8/88

CHART VIII-6. CALCULATION OF ENGINEERS' AVERAGE SALARY IN 1981

NATIONAL[a]					DoD LABS[b]					
LEVEL OF RESPON-SIBILITY	NUMBER	%	CUMU-LATIVE %	MEAN SALARY	GRADE LEVEL	NUMBER	%	CUMU-LATIVE %	AVER-AGE STEP	SALARY[c]
1	28,233	5.9	5.9	21,712	5	84	0.7	0.7	10	15,947
2	48,312	10.1	16.0	23,663	7	336	2.7	3.4	10	19,747
3	108,063	22.6	38.6	26,746	9	527	4.2	7.6	10	24,165
4	134,180	28.0	66.6	31,352	11	1,019	8.2	15.8	9.5	28,861
5	97,379	20.3	86.9	36,725	12	4,441	35.7	51.5	6.1	31,531
6	45,433	9.5	96.4	42,622	13	3,622	29.1	80.6	7.0	38,456
7	14,450	3.0	99.4	49,287	14	1,741	14.0	94.6	6.4	44,686
8	2,785	0.6	100.0	56,828	15	674	5.4	100.0	6.2	52,269
TOTAL	478,835	100.0			TOTAL	12,444	100.0			

[a] FROM BUREAU OF LABOR STATISTICS (REF. 12).
[b] FROM DMDC, EXCEPT SALARIES.
[c] FROM 1981 ANNUAL SALARY RATES (REF. 15).

JM:kg-3
6/5/89.

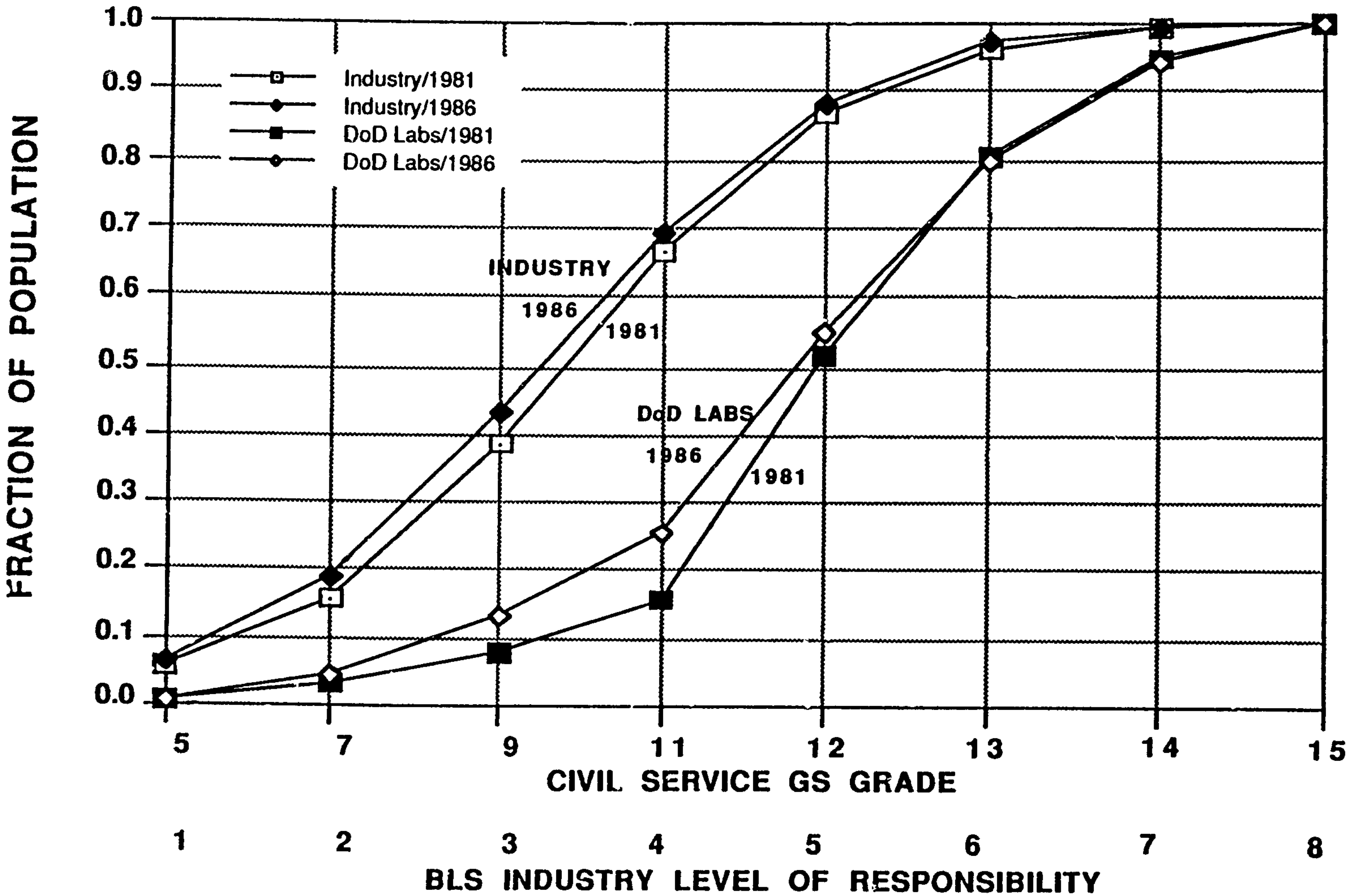
CHART VIII-7. CALCULATION OF ENGINEERS' AVERAGE SALARY IN 1986

NATIONAL[a]					DoD LABS[b]					
LEVEL OF RESPON-SIBILITY	NUMBER	%	CUMU-LATIVE %	MEAN SALARY	GRADE LEVEL	NUMBER	%	CUMU-LATIVE %	AVER-AGE STEP	SALARY[c]
1	40,469	6.8	6.8	27,866	5	71	0.5	0.5	10	18,710
2	71,336	12.0	18.8	31,194	7	602	4.3	4.8	10	23,170
3	145,165	24.4	43.2	35,715	9	1,150	8.2	13.0	10	28,347
4	157,033	26.4	69.6	42,677	11	1,738	12.5	25.5	9.5	33,853
5	111,913	18.8	88.4	50,769	12	4,133	29.6	55.1	5.6	36,467
6	52,105	8.8	97.2	58,883	13	3,414	24.5	79.6	6.5	44,491
7	13,395	2.3	99.5	68,602	14	2,038	14.6	94.2	6.4	52,427
8	3,097	0.5	100.0	79,021	15	807	5.8	100.0	6.2	61,320
TOTAL	594,513	100.0			TOTAL	13,953	100.0			

[a] FROM BUREAU OF LABOR STATISTICS (REF. 14).
[b] FROM DMDC, EXCEPT SALARIES.
[c] FROM 1986 ANNUAL SALARY RATES (REF. 16).

JM:kg-4
6/5/89

CHART VIII-8. CUMULATIVE DISTRIBUTION OF ENGINEERS IN U.S. INDUSTRY [a] AND IN DoD LABS [b] DISTRIBUTED BY LEVELS OF RESPONSIBILITY AND GRADE, RESPECTIVELY



[a] SOURCE: BUREAU OF LABOR STATISTICS (Refs. 12 and 14).

[b] SOURCE: DMDC; ALL SERIES-800 JOB CODES.

JM/ad-Chart 87
:1/11/88

CHART VIII-9. ANNUAL SALARIES OF Ph.D. PHYSICISTS IN DoD LABS BY NUMBER OF YEARS SINCE RECEIVING DOCTORATE[a]

YEARS SINCE RECEIVING DOCTORATE	NUMBER OF PEOPLE		MEDIAN AGE		MEAN SALARY[b]		STANDARD DEVIATION	
	1981	1986	1981	1986	1981	1986	1981	1986
0-4	56		34		30,364		4,775	
		102		33		35,915		5,443
5-9	166		38		34,708		5,079	
		154		38		42,158		6,287
10-14	266		41		40,289		5,798	
		205		42		46,340		7,245
15-19	156		46		44,794		4,863	
		251		47		52,217		7,970
20-24	66		51		45,485		5,190	
		150		51		56,098		7,872
25+	73		56		48,665		3,131	
		113		58		59,749		7,615
TOTAL OR WEIGHTED AVERAGE	783				40,503			
		975				49,153		

[a] SOURCE: DMDC; JOB CODE 1310.

[b] MEAN SALARY INCREASES FOR PHYSICISTS IN YEAR GROUPS 5-9, 20-24, AND MORE-THAN-24 MATCHED OR SLIGHTLY EXCEEDED (BY 1 OR 2 PERCENT) THE 21-PERCENT INFLATION THAT CONSUMER PRICE INDEXES INDICATE THE U.S. EXPERIENCED IN THE FIVE-YEAR PERIOD; MEAN SALARIES OF PHYSICISTS IN OTHER YEAR GROUPS DID NOT KEEP PACE WITH INFLATION. THE 1986 WEIGHTED AVERAGE SALARY IS BARELY MORE THAN $49,009, THE 1981 WEIGHTED AVERAGE SALARY INCREASED BY 21 PERCENT TO MATCH FIVE YEARS' INFLATION.

JM:kg-49
11/8/88

CHART VIII-10. PERCENTILE SALARIES OF Ph.D. PHYSICISTS IN DoD LABS BY NUMBER OF YEARS SINCE RECEIVING DOCTORATE

YEARS SINCE RECEIVING DOCTORATE	PERCENTILE (P) SALARY									
	10P		25P		50P		75P		90P	
	1981	1986	1981	1986	1981	1986	1981	1986	1981	1986
0-4	26,951		27,849		29,196		33,207		36,213	
		31,960		32,673		35,835		38,997		41,282
5-9	28,747		30,543		34,184		38,017		41,660	
		34,781		37,599		41,320		44,804		50,685
10-14	32,339		36,320		40,395		44,181		49,056	
		37,943		41,232		45,598		50,202		56,011
15-19	38,136		40,592		45,443		50,112		50,112	
		41,358		46,182		51,835		57,759		62,994
20-24	38,456		41,393		47,967		50,112		50,112	
		46,248		48,876		57,194		62,343		67,939
25+	44,953		49,229		50,112		50,112		50,112	
		48,876		56,514		59,463		66,431		67,940

SOURCE: DMDC; JOB CODE 1310.

JM:kg-50
11/8/88

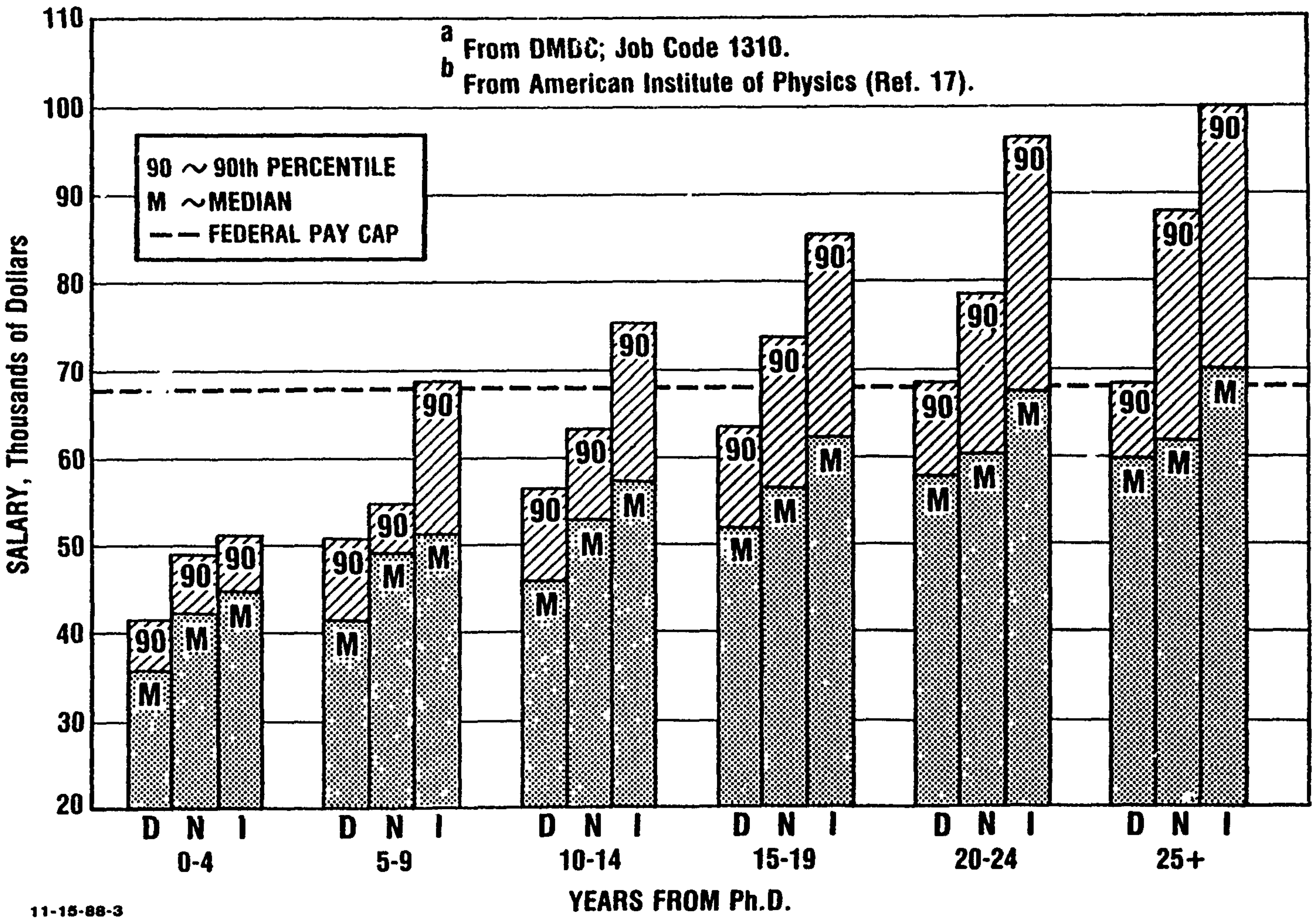
CHART VIII-11. DISTRIBUTION OF 1986 SALARIES OF Ph.D. MEMBERS[a] OF THE AMERICAN INSTITUTE OF PHYSICS (AIP)[b] AND Ph.D. S&E OF DoD LABS[c] BY NUMBER OF YEARS SINCE RECEIVING Ph.D.

YEARS SINCE RECEIVING DOCTORATE	NUMBER OF PEOPLE		MEDIAN AGE		MEAN SALARY		STANDARD DEVIATION	
	AIP[d]	LABS[e]	AIP	LABS	AIP	LABS	AIP	LABS
0-4	156	102	32	33	44,600	35,900	8,200	5,400
5-9	228	154	36	38	53,500	42,200	11,200	6,300
10-14	200	205	41	42	58,700	46,300	14,400	7,200
15-19	184	251	45	47	64,700	52,200	16,800	8,000
20-24	107	150	50	51	71,800	56,100	24,700	7,900
25+	153	113	59	58	74,800	59,700	25,300	7,600

a EMPLOYED IN INDUSTRY.
b FROM AMERICAN INSTITUTE OF PHYSICS (REF. 17).
c FROM DMDC; JOB CODE 1310.
d 1028 PH.D. RESPONDENTS TO AIP'S SALARY SURVEY.
e 975 PH.D. PHYSICISTS IN THE DoD LABS.

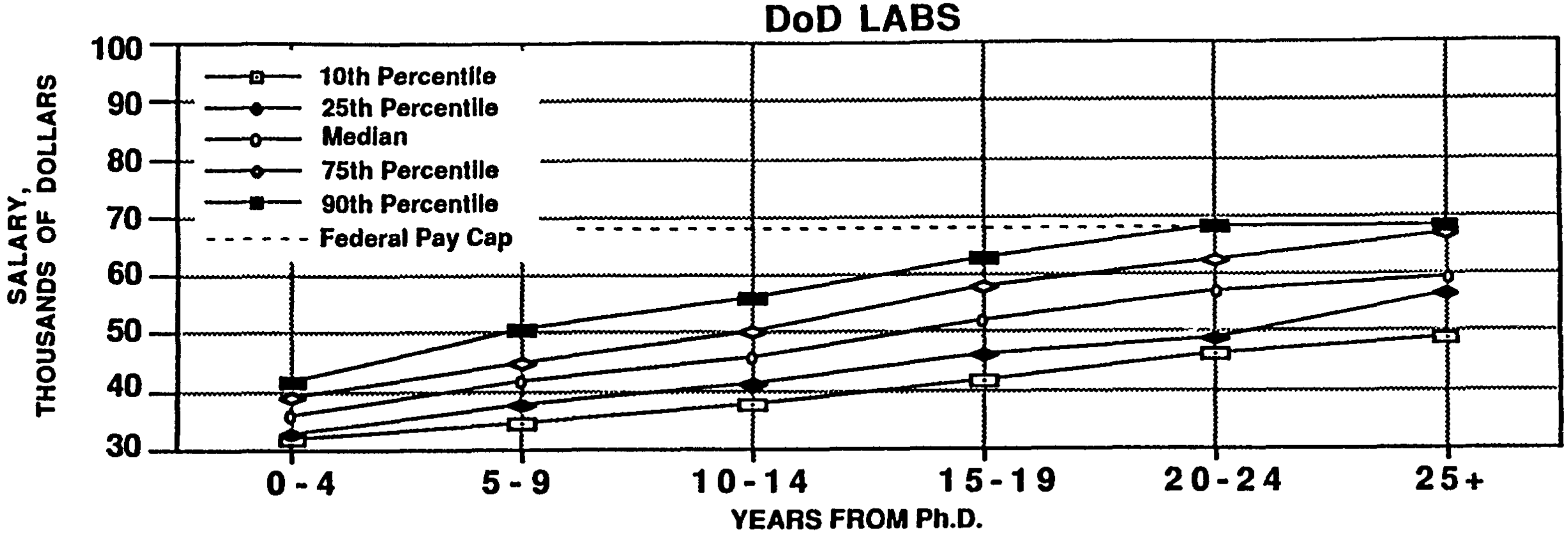
JM:kg-51
11/8/88

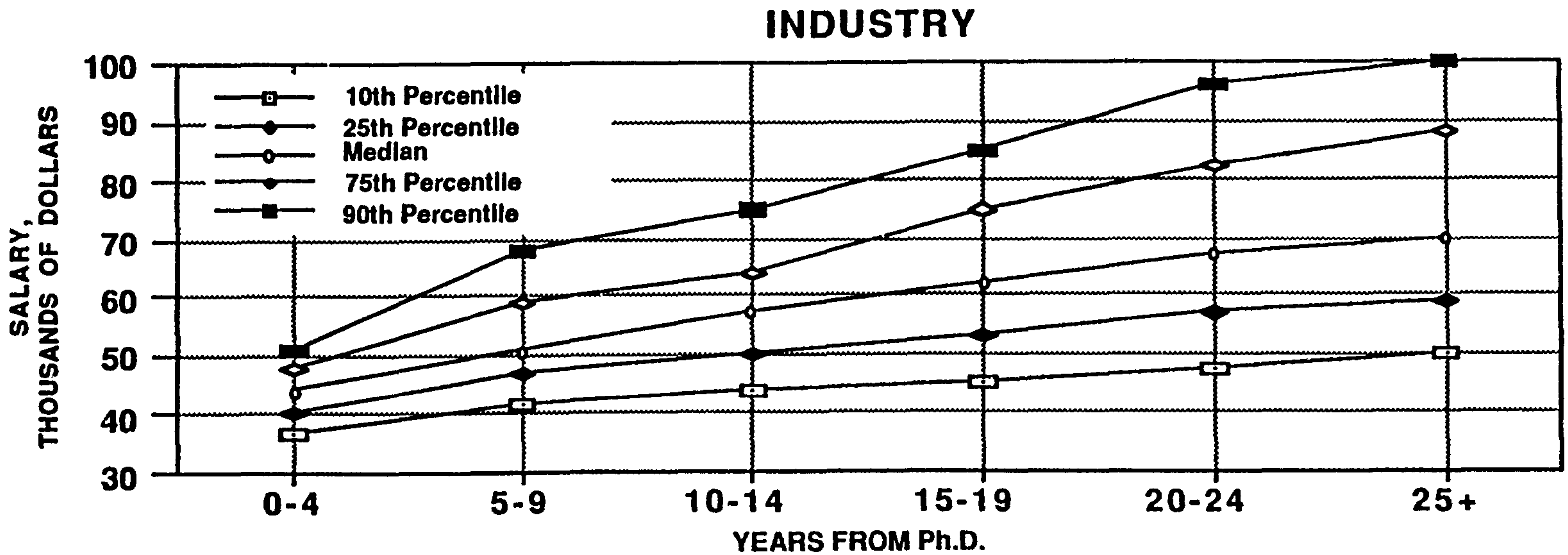
CHART VIII-12. 1986 SALARY STRUCTURE FOR PHYSICISTS IN DoD LABS (D)[a], NATIONAL LABS (N)[b], AND INDUSTRY (I)[b] BY NUMBER OF YEARS FROM Ph.D.



11-15-88-3

CHART VIII-13. 1986 SALARY STRUCTURE FOR DoD LAB PHYSICISTS AND AIP MEMBERS IN INDUSTRY BY NUMBER OF YEARS FROM Ph.D.[a]

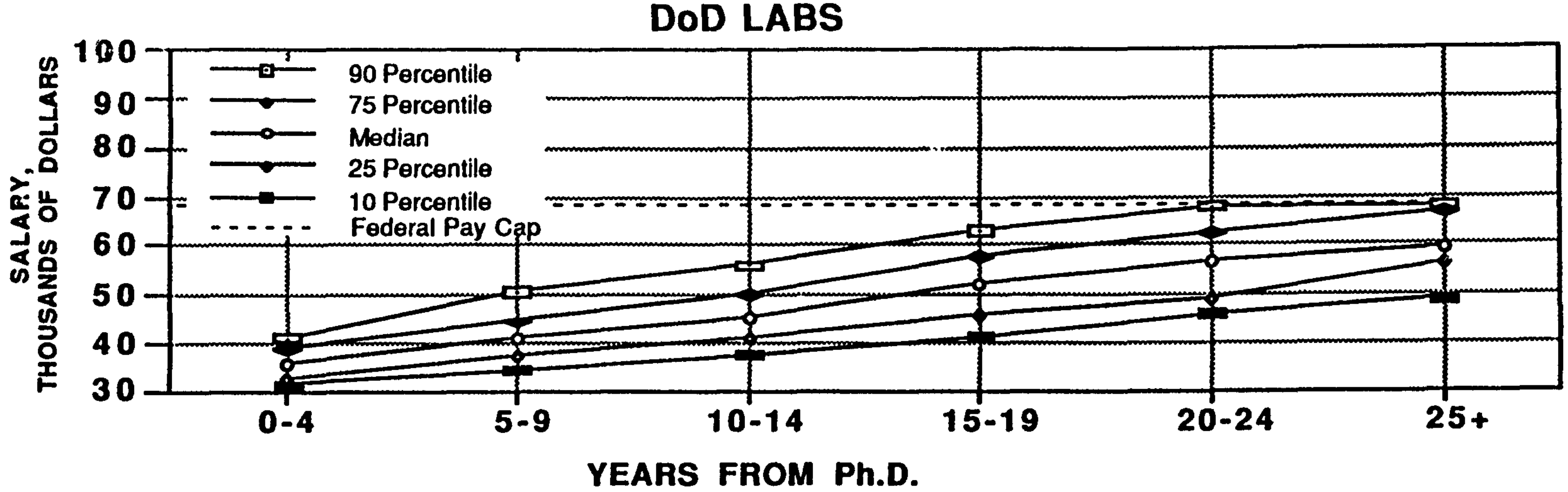


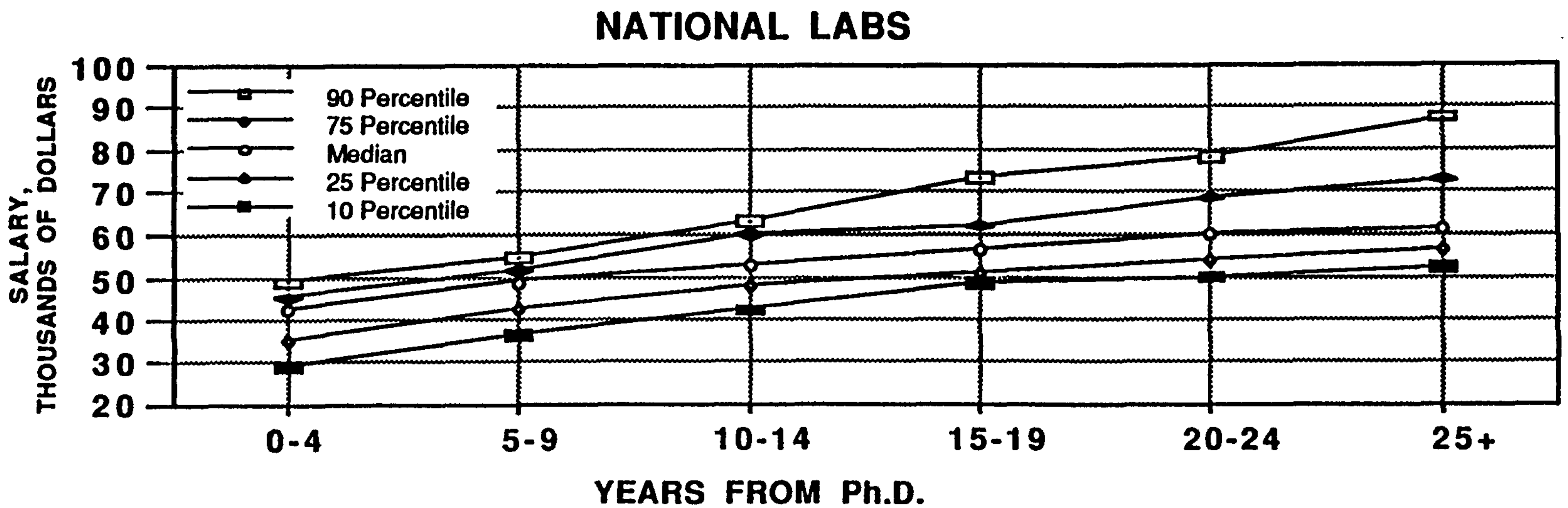


[a] FROM AMERICAN INSTITUTE OF PHYSICS (Ref. 17).

JM:ad-ChtVIII-13
7/10/89

CHART VIII-14. 1986 SALARY STRUCTURE FOR DOD LABS PHYSICISTS AND AIP MEMBERS IN THE NATIONAL LABS BY NUMBER OF YEARS FROM Ph.D.[a]





[a] FROM AMERICAN INSTITUTE OF PHYSICS (REF. 17).

CHART VIII-15. 1986 SALARIES OF IEEE MEMBERS[a] AND DoD LAB ELECTRICAL AND ELECTRONICS ENGINEERS[b] BY LEVEL OF RESPONSIBILITY OR EQUIVALENT DoD GRADE LEVEL

LEVEL OF RESPONSIBILITY/ GRADE LEVEL[c]	NUMBER OF PEOPLE		MEAN SALARY		STANDARD DEVIATION		MEDIAN SALARY	
	IEEE	LABS	IEEE	LABS	IEEE	LABS	IEEE	LABS
1 / GS 5	51	32	32,000	18,700	10,600	100	29,400	18,700
2 / GS 7	219	301	30,700	23,200	5,400	900	30,000	23,200
3 / GS 9	645	516	35,500	27,900	17,800	1,300	33,600	27,800
4 / GS 11	1,092	642	40,800	31,400	8,500	2,000	39,800	30,900
5 / GS 12	1,140	1,661	47,100	39,100	11,100	3,400	46,000	39,500
6 / GS 13	1,380	1,367	52,900	44,500	12,400	3,500	50,900	44,000
7 / GS 14	1,231	754	59,900	51,900	17,500	4,200	58,000	51,900
8 / GS 15	674	269	69,300	61,200	19,500	4,000	66,000	61,000
9 / GS 16-18	476	2	87,700	63,800	38,300	0	78,000	63,800

[a] FROM THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (REF. 18).
[b] FROM DMDC; JOB CODES 850 AND 855.
[c] IEEE USES THE BLS SYSTEM FOR DEFINING WORK LEVELS, WHICH CORRESPOND TO FEDERAL GS GRADE LEVELS.

JM:kg-52
11/8/88

CHART VIII-16. 1986 MEAN SALARIES OF IEEE MEMBERS [a] AND DoD LAB ELECTRICAL AND ELECTRONICS ENGINEERS [b], ALL WITH 15-20 YEARS EXPERIENCE, BY LEVEL OF RESPONSIBILITY OR EQUIVALENT DoD GRADE LEVEL

LEVEL OF RESPONSIBILITY/ GRADE LEVEL[c]	MEAN SALARY	
	IEEE	LABS
3 / GS 9	41,600	31,400
4 / GS 11	47,000	34,300
5 / GS 12	50,200	40,400
6 / GS 13	53,500	43,200
7 / GS 14	59,000	49,600
8 / GS 15	70,800	59,400

[a] FROM THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (REF. 18).
[b] FROM DMDC; JOB CODES 850 AND 855.
[c] IEEE MEMBERS AND LAB S&E ARE SUBSETS, WHICH HAVE 15-20 YEARS EXPERIENCE, OF THE GROUPS SHOWN IN CHART VIII-15.

JM:kg-53
11/8/88

CHART VIII-17. 1986 SALARIES OF IEEE MEMBERS[a] AND DoD LAB ELECTRICAL AND ELECTRONIC ENGINEERS[b] BY AGE

AGE, YEAR GROUP	NUMBER OF PEOPLE		MEAN SALARY		STANDARD DEVIATION		MEDIAN SALARY	
	IEEE	LABS	IEEE	LABS	IEEE	LABS	IEEE	LABS
<30	1,383	1,775	35,400	29,500	11,500	4,500	34,000	29,300
30-40	2,339	1,788	49,000	38,900	15,500	6,000	47,000	39,500
40-49	1,854	1,798	61,300	46,900	22,900	7,000	57,000	45,200
50-59	1,321	1,269	66,600	49,600	33,100	7,700	60,400	48,900
60+	520	252	68,100	47,700	33,100	9,100	60,900	47,200

[a] FROM THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (REF. 18).
[b] FROM DMDC; JOB CODES 850 AND 855.

JM:kg-54
11/8/88

CHART VIII-18. 1986 MEAN SALARIES OF IEEE MEMBERS[a] AND DoD LAB ELECTRICAL AND ELECTRONICS ENGINEERS[b], ALL WITH 15-20 YEARS EXPERIENCE, BY AGE

AGE, YEAR GROUP[c]	MEAN SALARY	
	IEEE	LABS
30-40	57,200	42,800
40-49	61,000	45,400
50-59	60,000	48,400
60+	53,600	47,000

[a] FROM THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (REF. 18).
[b] FROM DMDC; JOB CODES 850 AND 855.
[c] IEEE MEMBERS AND LAB S&E ARE SUBSETS, WHICH HAVE 15-20 YEARS EXPERIENCE, OF THE GROUPS SHOWN IN CHART VIII-17.

JM:kg-55
11/8/88

CHART VIII-19. 1986 SALARIES OF IEEE MEMBERS[a] AND DoD LAB ELECTRICAL AND ELECTRONICS ENGINEERS[b] BY YEARS OF EXPERIENCE

YEARS OF EXPERIENCE	NUMBER OF PEOPLE		MEAN SALARY		STANDARD DEVIATION		MEDIAN SALARY	
	IEEE	LABS	IEEE	LABS	IEEE	LABS	IEEE	LABS
<2	417	782	32,600	27,700	16,800	5,500	30,000	27,800
3-4	710	783	36,300	30,700	13,700	4,500	34,000	30,000
5-7	905	704	41,800	34,200	10,000	5,600	39,500	34,000
8-10	786	455	48,000	36,900	13,100	4,800	53,100	37,300
11-15	1,123	858	54,100	41,700	16,100	5,500	50,500	40,700
16-20	1,032	1,104	60,900	44,900	22,000	6,100	56,800	43,400
21-25	794	961	63,700	48,200	25,000	6,400	60,000	47,600
26-30	785	803	67,600	50,500	36,200	7,300	60,000	48,900
30+	860	431	68,700	51,500	31,300	7,800	62,400	48,900

[a] FROM THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (REF. 18).
[b] FROM DMDC; JOB CODES 850 AND 855.

JM:kg-56
11/11/88

CHART VIII-20. 1986 SALARIES OF IEEE MEMBERS[a] AND DoD LAB ELECTRICAL AND ELECTRONICS ENGINEERS[b] BY LEVEL OF EDUCATION

EDUCATION LEVEL	NUMBER OF PEOPLE		MEAN SALARY	
	IEEE	LABS	IEEE	LABS
< BACHELOR'S	149	121	46,200	35,000
BACHELOR'S	3,443	3,786	47,800	38,100
MASTER'S	2,584	1,403	56,700	45,200
DOCTOR'S	957	235	69,100	50,200

[a] FROM THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (REF. 18).
[b] FROM DMDC; JOB CODES 850 AND 855.

JM:kg-57
11/11/88

CHART VIII-21. SALARIES OF NSPE MEMBERS[a] AND DoD LAB ENGINEERS[b] BY LEVEL OF RESPONSIBILITY OR EQUIVALENT DoD GRADE LEVEL

LEVEL OF RESPONSIBILITY OR GRADE LEVEL[c]	NUMBER OF PEOPLE		MEAN SALARY	
	NSPE	LABS	NSPE	LABS
1-2 / GS 5-7	240	673	29,286	22,734
3 / GS 9	657	1,150	32,869	27,458
4 / GS 11	1,845	1,738	39,776	30,756
5 / GS 12	2,484	4,132	45,555	37,486
6 / GS 13	2,535	3,414	52,251	44,468
7 / GS 14	2,050	2,038	61,267	52,331
8 / GS 15	1,782	807	72,841	61,878
9 / GS 16-18	966	3	100,069	63,800

[a] FROM NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS (REF. 19).
[b] FROM DMDC; ALL SERIES-800 JOB CODES.
[c] NSPE USES THE BLS SYSTEM FOR DEFINING WORK LEVELS, WHICH CORRESPOND TO FEDERAL GS GRADE LEVELS.

JM:kg-58
11/11/88

CHART VIII-22. 1986 SALARY STRUCTURE FOR ENGINEERS OF SELECTED LEVELS/GRADES, DoD LAB EMPLOYEES (D)[a] AND NSPE MEMBERS (N)[b]

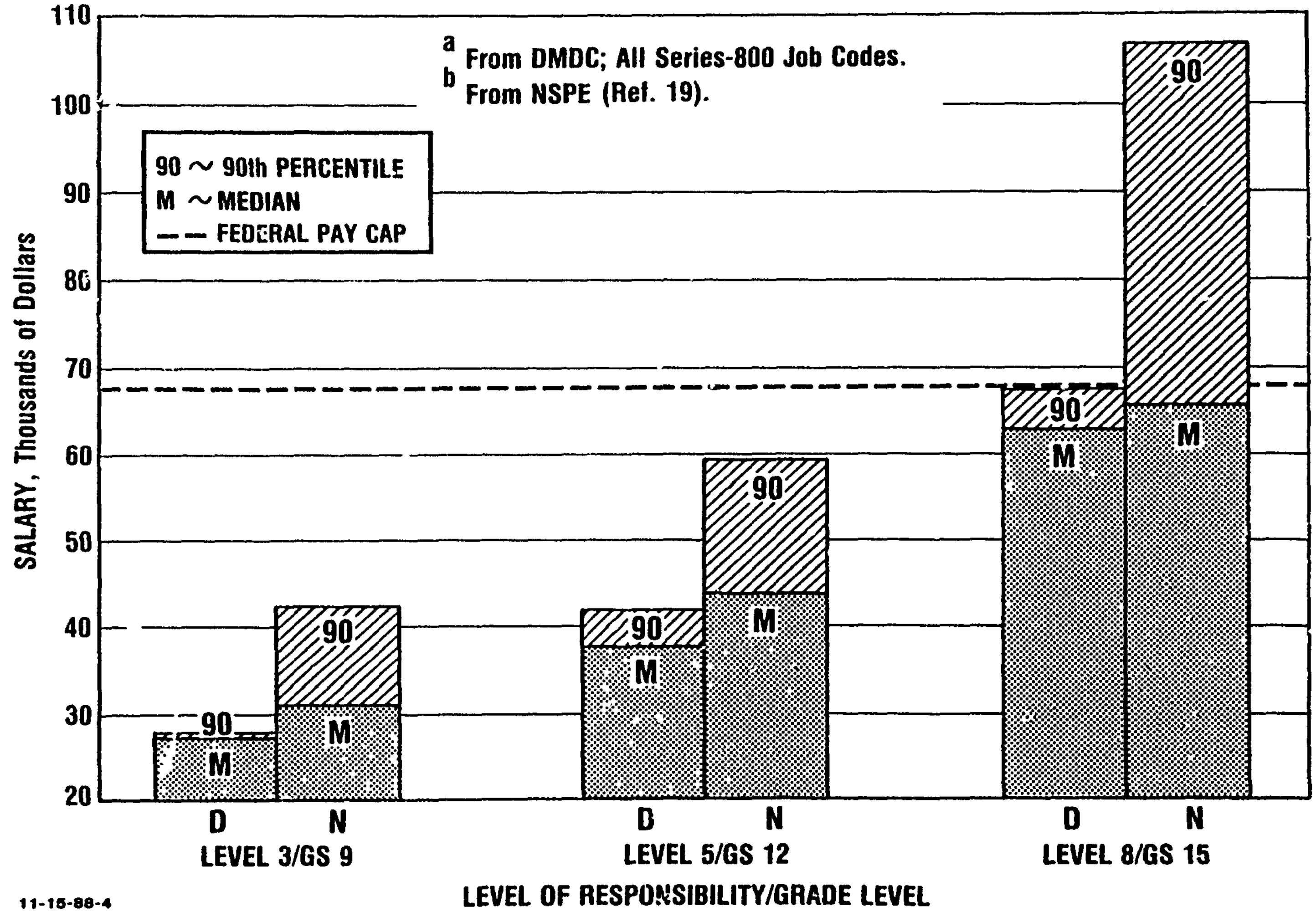


CHART VIII-23. 1986 PERCENTILE SALARIES FOR NSPE MEMBERS[a] AND DoD LAB ENGINEERS[b] BY LEVEL OF RESPONSIBILITY OR EQUIVALENT DoD GRADE LEVEL

LEVEL OF RESPONSIBILITY/ GRADE LEVEL	NO. OF PEOPLE		PERCENTILE									
			10		25		50		75		90	
	NSPE	LABS	NSPE	LABS	NSPE	LABS	NSPE	LABS	NSPE	LABS	NSPE	LABS
1-2 / GS 5-7	240	673	21,450	22,702	24,000	22,702	28,040	22,702	31,450	22,702	37,984	22,702
3 / GS 9	657	1,150	24,477	26,893	27,968	26,893	30,900	27,595	36,300	27,834	42,099	27,834
4 / GS 11	1,845	1,738	29,055	29,018	32,889	29,018	37,800	30,034	43,509	31,568	50,250	32,671
5 / GS 12	2,484	4,132	33,500	32,673	37,800	34,034	43,341	37,322	50,160	40,610	58,908	41,706
6 / GS 13	2,535	3,414	37,850	40,105	42,600	41,358	49,520	44,187	58,000	47,925	68,560	48,876
7 / GS 14	2,050	2,038	41,673	47,392	49,000	49,935	56,576	52,393	67,982	55,268	84,000	57,759
8 / GS 15	1,782	807	45,000	56,026	53,600	58,986	65,000	62,065	80,000	65,231	106,000	67,940
9 / GS 16-18	966	3	52,640	63,800	66,306	63,800	84,000	63,800	112,200	63,800	160,000	63,800

[a] FROM NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS (REF. 19).
[b] FROM DMDC; ALL SERIES-800 JOB CODES.

JM:kg-59
11/11/88

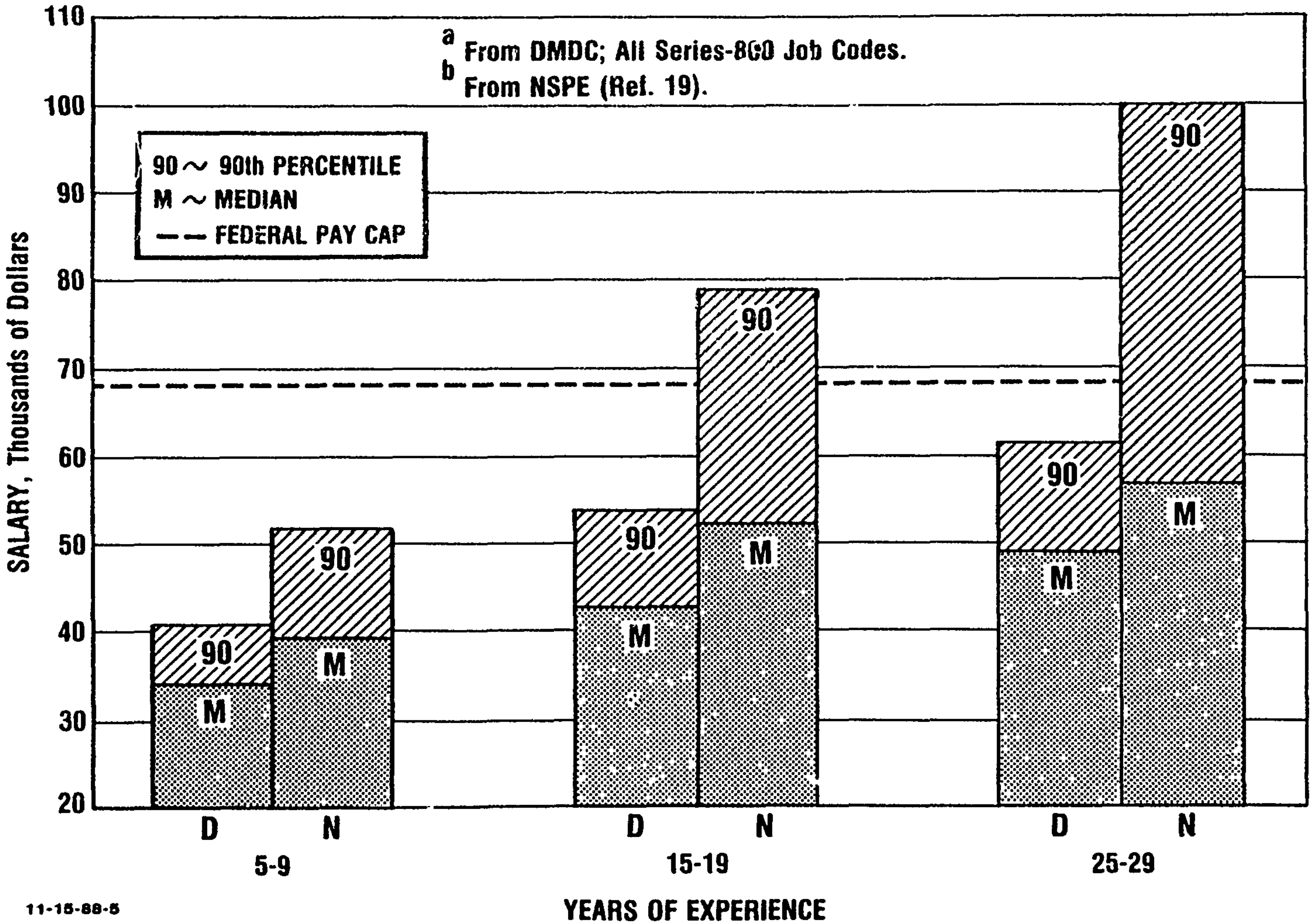
CHART VIII-24. SALARIES OF NSPE MEMBERS[a] AND DoD LAB ENGINEERS[b] BY LENGTH OF EXPERIENCE

LENGTH OF EXPERIENCE, YEARS	NUMBER OF PEOPLE		MEAN SALARY	
	NSPE	LABS	NSPE	LABS
1	183	539	28,687	26,671
2	286	1,263	30,288	28,090
3	329	912	31,840	29,965
4	313	1,034	35,175	31,208
5-9	1,844	2,747	41,027	34,487
10-14	1,940	1,554	49,309	40,102
15-19	1,819	2,257	56,906	44,468
20-24	1,598	2,156	62,586	47,411
25-29	1,830	2,153	65,860	50,438
30+	3,253	1,537	70,331	52,269

[a] FROM NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS (REF. 19).
[b] FROM DMDC; ALL SERIES-800 JOB CODES.

JM:kg-60
11/11/88

CHART VIII-25. 1986 SALARY STRUCTURE FOR ENGINEERS WITH SELECTED LENGTHS OF EXPERIENCE, DoD LAB EMPLOYEES (D)[a] AND NSPE MEMBERS (N)[b]



11-15-88-5

CHART VIII-26. 1986 PERCENTILE SALARIES FOR NSPE MEMBERS[a] AND DoD LAB ENGINEERS[b] BY LENGTH OF EXPERIENCE

YEARS OF EXPERIENCE	NO. OF PEOPLE		PERCENTILE									
			10		25		50		75		90	
	NSPE	LABS	NSPE	LABS	NSPE	LABS	NSPE	LABS	NSPE	LABS	NSPE	LABS
1	183	539	21,626	18,710	24,030	23,170	28,347	26,893	30,675	27,834	34,402	34,118
2	286	1,263	23,001	23,170	26,500	25,140	29,500	27,591	32,800	29,018	36,000	34,816
3	329	912	24,922	26,444	28,053	27,595	31,000	29,018	34,500	30,718	38,652	35,130
4	313	1,034	26,782	27,595	30,382	29,285	33,960	30,718	37,602	32,673	43,288	34,034
5-9	1,844	2,747	30,893	29,018	34,680	31,619	39,177	34,034	44,596	37,322	51,508	40,679
10-14	1,940	1,554	34,820	34,781	40,000	36,889	46,085	40,051	54,000	41,803	65,225	45,964
15-19	1,819	2,257	37,800	37,943	44,000	40,105	51,800	42,611	62,000	47,474	78,560	53,316
20-24	1,598	2,156	38,997	40,051	45,084	42,611	55,180	46,370	69,900	51,103	90,000	57,478
25-29	1,830	2,153	40,000	41,105	46,500	45,117	56,625	48,876	73,500	54,822	100,000	60,991
30+	3,253	1,537	39,972	41,105	48,000	47,386	60,000	48,876	78,000	57,759	110,000	65,955

[a] FROM NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS (REF. 19).
[b] FROM DMDC; ALL SERIES-800 JOB CODES.

JM:kg-61
11/11/88

CHART VIII-27. 1986 SALARIES OF NSPE MEMBERS[a] AND DoD LAB ENGINEERS[b] BY BRANCH OF ENGINEERING

ENGINEERING BRANCH	NUMBER OF PEOPLE		MEAN SALARY	
	NSPE	LABS	NSPE	LABS
CIVIL[c]	4,312	611	54,712	39,072
MECHANICAL[d]	2,329	3,602	58,779	37,394
EE[e]	2,280	6,882	56,009	40,842

a FROM NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS (REF. 19); NSPE SAMPLE POPULATIONS SHOWN.
b FROM DMDC; DoD LAB POPULATIONS SHOWN.
c JOB CODE 810.
d JOB CODE 830.
e ELECTRICAL AND ELECTRONICS ENGINEERS, JOB CODES 850 AND 855.

CHART VIII-28. 1986 SALARY STRUCTURE FOR CIVIL ENGINEERS, DoD LAB EMPLOYEES (D)[a] AND NSPE MEMBERS (N)[b]

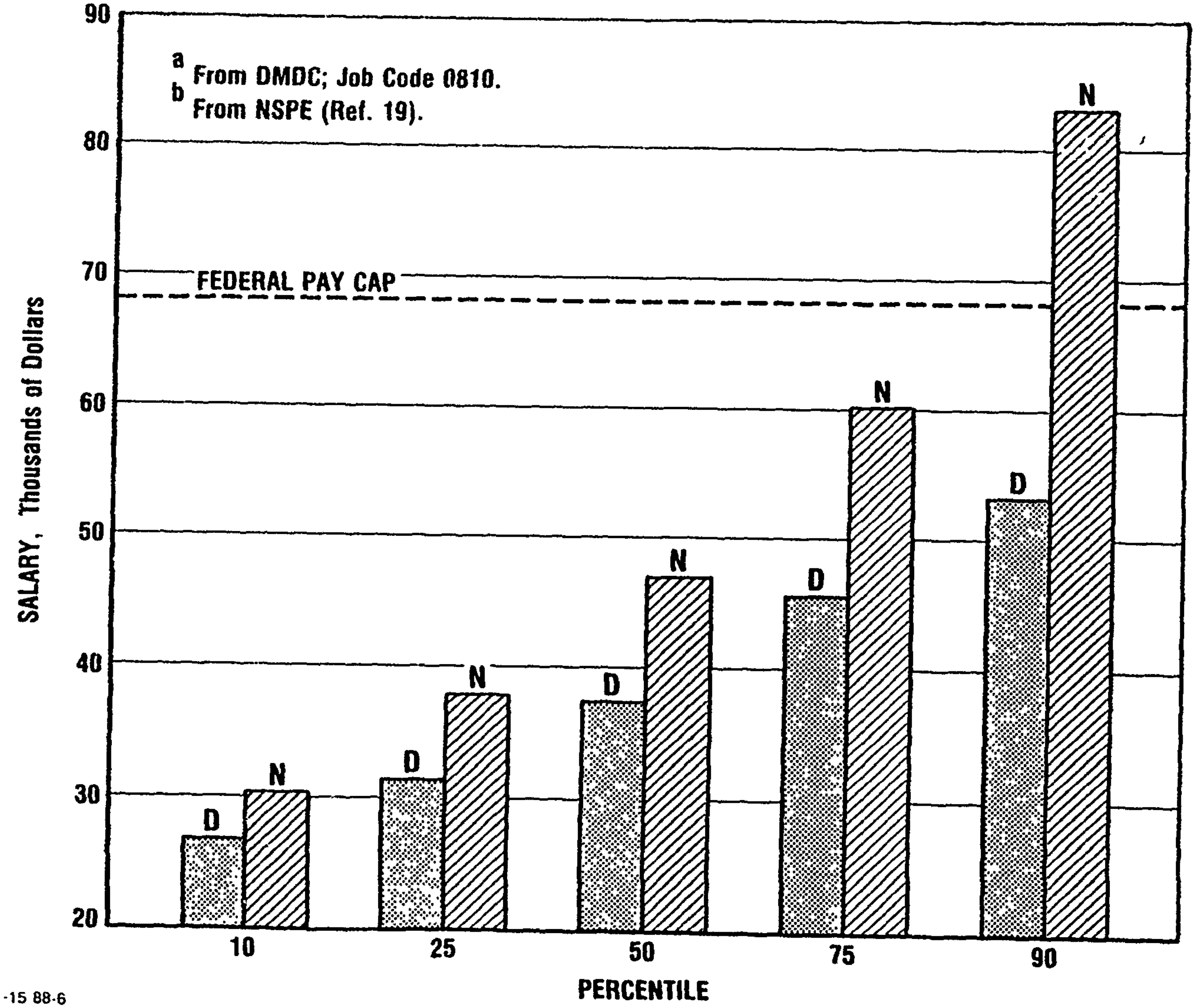
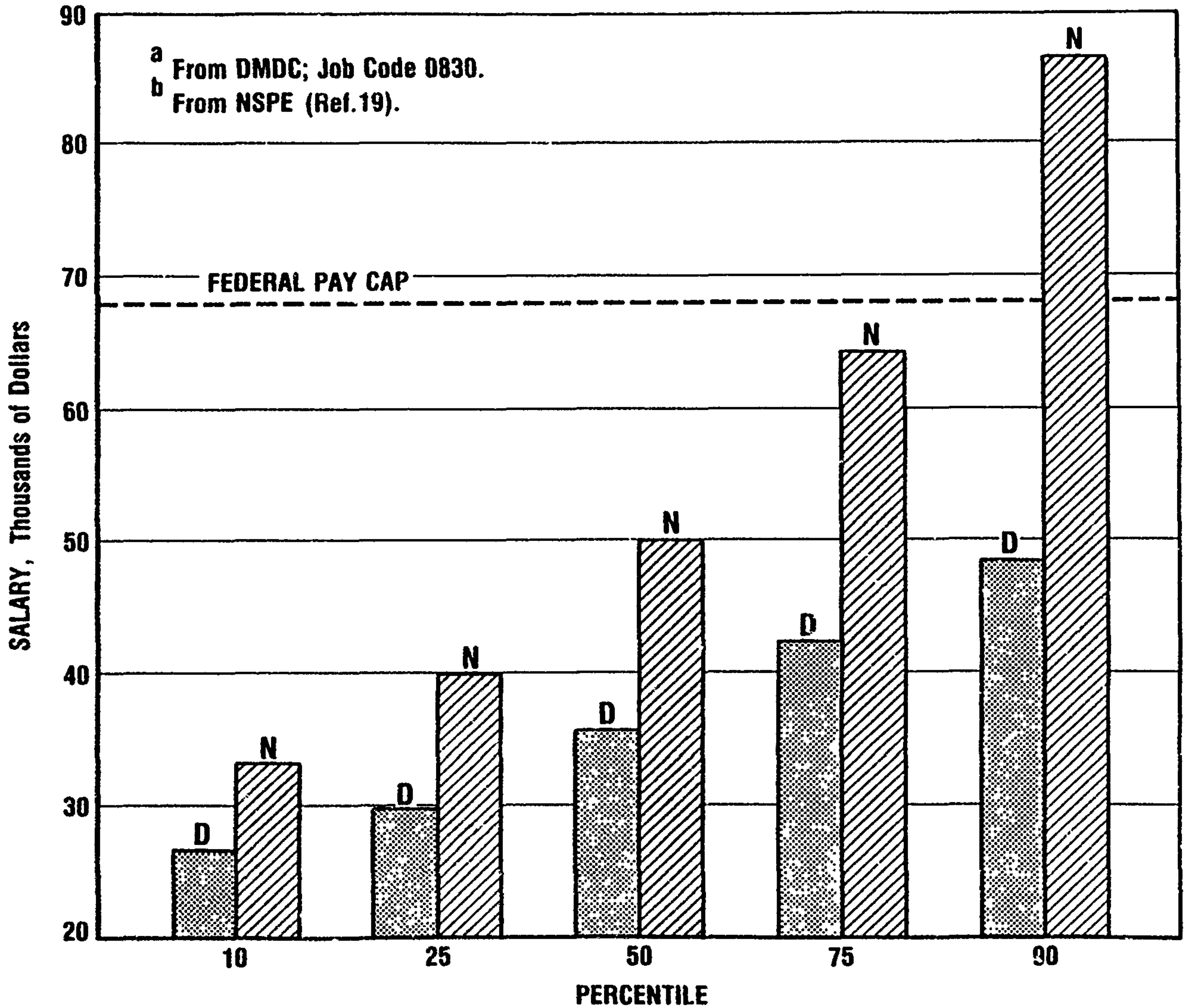
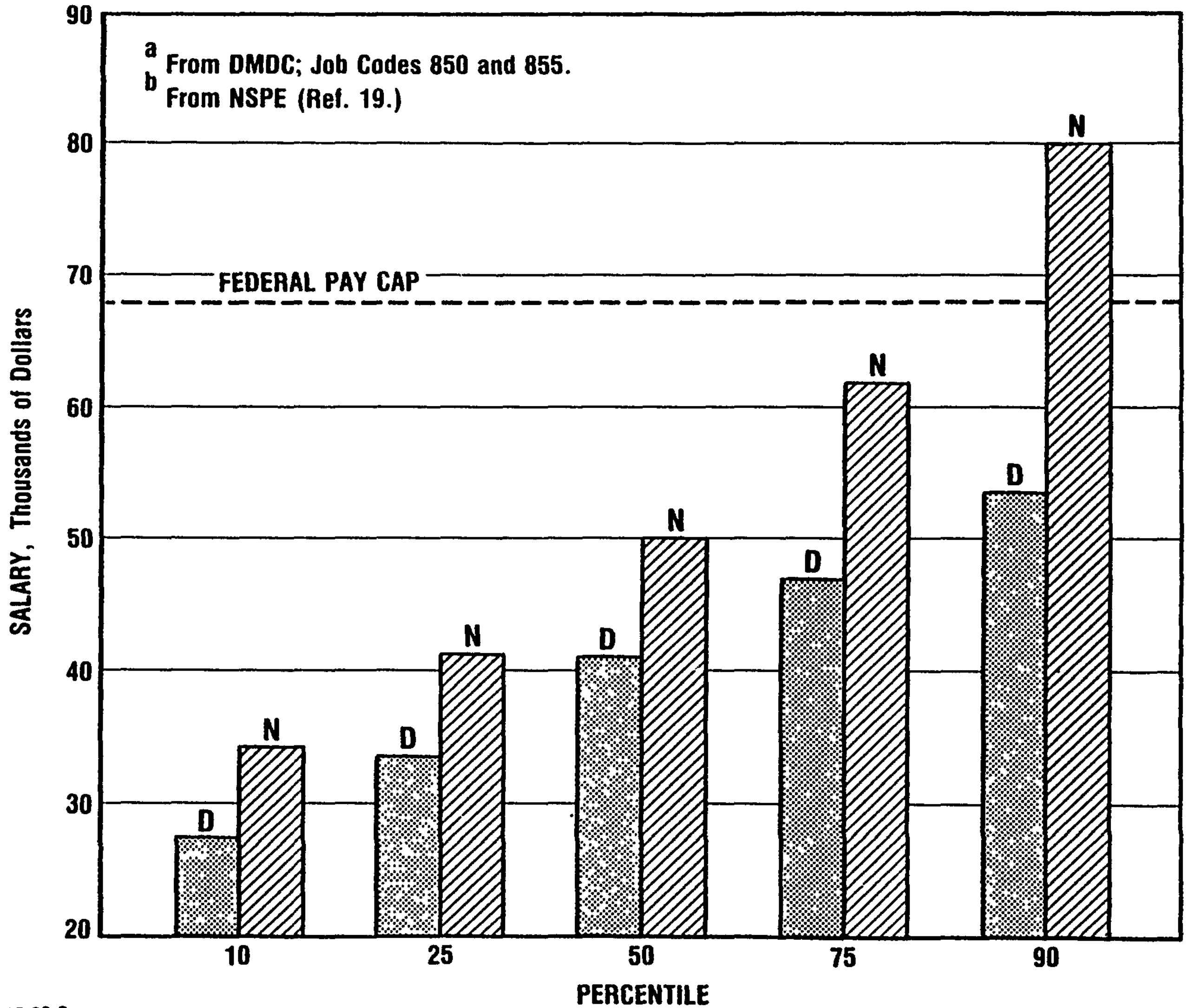


CHART VIII-29. 1986 SALARY STRUCTURE FOR MECHANICAL ENGINEERS, DoD LAB EMPLOYEES (D)[a] AND NSPE MEMBERS (N)[b]



11-15-99-7

CHART VIII-30. 1986 SALARY STRUCTURE FOR ELECTRICAL AND ELECTRONICS ENGINEERS, DoD LAB EMPLOYEES (D)[a] AND NSPE MEMBERS (N)[b]



11-15-89-8

CHART VIII-31. MEAN SALARIES OF NSPE MEMBERS[a] AND DoD LAB ENGINEERS[b] BY LEVEL OF EDUCATION

EDUCATION LEVEL	NUMBER OF PEOPLE		MEAN SALARY		MEDIAN SALARY	
	NSPE	LABS	NSPE	LABS	NSPE	LABS
LESS THAN BACHELOR'S	330	398	58,525	37,709	50,000	36,889
BACHELOR'S	8,531	10,724	54,233	38,438	46,978	37,943
MASTER'S	3,829	4,084	59,130	44,980	51,731	43,864
DOCTOR'S	698	877	68,889	49,679	61,325	48,876

[a] FROM NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS (REF. 19).
[b] FROM DMDC; ALL SERIES-800 JOB CODES.

JM:kg-63
11/11/88

CHART VIII-32. AVERAGE ANNUAL SALARY AS A FUNCTION OF TIME SINCE RECEIVING BACHELOR'S DEGREE[a]

NUMBER OF YEARS SINCE RECEIVING BACHELOR'S DEGREE	NATIONAL R&D[b]		DoD LABS[c]	
	1981	1986	1981	1986
1	22,980	27,780	20,689	25,150
2	23,940	29,112	22,038	26,901
3	24,948	30,960	23,961	29,326
4	25,812	32,736	25,072	30,657
5	26,508	33,948	26,170	32,135
6	27,156	35,760	27,605	33,622
7	28,032	36,948	28,852	34,374
8	29,136	37,872	29,244	35,285
9	30,024	39,048	29,685	35,873
10	30,648	40,176	30,141	37,039
11	31,308	40,692	30,943	37,890
12	32,592	41,700	31,589	38,415
13	33,684	43,272	32,921	39,196
14	34,344	44,292	33,139	40,297
15	34,716	44,616	34,510	41,049

[a] APPLIES ONLY TO THOSE S&E WHOSE HIGHEST DEGREE IS BACHELOR'S.
[b] FROM DEPARTMENT OF ENERGY, REFS. 20 AND 21.
[c] FROM DMDC.

JM:kg-48
11/8/88

CHART VIII-32. AVERAGE ANNUAL SALARY AS A FUNCTION OF TIME SINCE RECEIVING BACHELOR'S DEGREE [a] (Continued)

NUMBER OF YEARS SINCE RECEIVING BACHELOR'S DEGREE	NATIONAL R&D[b]		DoD LABS[c]	
	1981	1986	1981	1986
16	35,304	45,744	34,726	41,733
17	36,240	47,520	35,420	41,590
18-19	37,104	48,732	36,663	43,161
20-21	37,884	49,932	38,245	44,582
22-23	38,796	50,700	39,269	46,137
24-25	39,120	52,668	39,806	46,946
26-27	39,828	53,208	39,857	48,134
28-29	39,588	54,480	40,055	49,130
30-31	39,432	53,940	40,560	48,927
32-33	39,708	53,988	40,399	48,901
34-35	39,516	54,408	39,214	48,898
36-40	39,276	53,952	39,994	46,884
41-50	39,108	53,232	37,855	45,743
ALL S&E AVERAGE	32,256	41,484	34,593	38,139

[a] APPLIES ONLY TO THOSE S&E WHOSE HIGHEST DEGREE IS BACHELOR'S.
[b] FROM DEPARTMENT OF ENERGY, REFS. 20 AND 21.
[c] FROM DMDC.

JM:kg-48a
11/8/88

CHART VIII-33. CY-1987 SALARIES OF ALL NONSUPERVISORY S&E AT THE BACHELOR'S DEGREE LEVEL

	N[b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
MATURITY[a]	DoD[c]	DoE[d]	DoD	DoE	DoD	DoE	DoD	DoE	DoD	DoE
0	269	450	23,796	29,436	23,865	29,736	23,865	30,768	28,325	31,944
1	1,172	932	26,745	30,720	27,493	30,900	29,197	32,208	29,197	33,756
2	1,098	938	28,979	32,112	29,197	32,352	31,383	33,996	31,863	35,868
3	1,195	867	31,518	33,708	31,863	33,816	33,674	35,904	35,756	37,932
4	822	696	32,680	35,316	33,194	35,400	34,739	37,716	36,885	40,044
5	578	736	34,194	36,648	34,739	36,780	36,885	39,552	38,014	42,528
6	498	659	35,498	39,000	35,824	39,420	38,014	42,288	40,018	45,492
7	355	576	35,974	39,624	35,824	39,624	38,789	43,452	41,122	47,196
8	301	425	37,025	41,028	37,996	41,232	40,272	45,180	41,875	48,444
9	245	349	37,704	41,496	38,011	41,388	40,814	45,828	42,599	48,648
10	231	307	38,216	42,000	39,143	41,676	41,308	46,224	43,761	50,604
11	240	245	39,375	43,140	40,023	43,452	42,599	47,820	43,889	53,316
12	293	252	39,773	43,296	40,167	43,248	42,599	47,688	45,255	51,228
13	247	221	40,523	44,784	41,401	45,060	43,659	49,680	46,471	54,828
14	294	198	41,729	45,456	42,530	45,276	44,533	51,144	48,108	56,364
15	287	176	41,973	46,536	42,530	46,212	44,421	51,468	47,773	57,588
16	231	208	42,243	47,280	42,599	47,304	44,966	53,148	48,675	58,272
17	251	175	42,581	49,032	42,599	49,104	45,566	54,048	50,015	61,212
18	281	194	43,440	49,152	43,424	49,152	46,596	54,168	50,342	60,540
19	239	188	43,935	51,528	43,659	52,572	47,327	57,336	50,504	61,452
20	238	162	45,319	52,752	45,180	51,312	47,697	57,768	52,818	61,632
21	273	139	45,027	51,048	45,180	51,240	48,961	56,784	52,131	62,256
22-23	518	263	46,479	52,248	46,149	52,080	50,342	57,768	54,524	64,488
24-25	550	308	46,840	53,448	46,471	53,652	50,342	59,736	53,418	65,460
26-27	649	349	48,158	53,760	48,863	53,748	50,342	59,232	56,990	65,424
28-29	512	326	48,585	55,608	50,100	55,572	50,342	61,368	58,105	66,264
30-31	294	228	48,234	55,284	48,921	55,608	50,342	62,016	59,323	65,976
32-33	207	202	48,376	54,996	50,339	56,052	50,342	61,212	59,492	65,892
34-35	254	259	48,344	56,436	48,898	56,352	50,342	62,928	59,492	70,104
36-40	342	423	46,935	56,100	46,471	56,076	50,342	62,040	59,440	68,016
41-50	85	99	46,300	55,452	43,424	56,172	50,342	62,460	59,492	65,292
>50	7	0	45,664		43,424		50,342		59,492	
UNKNOWN	86	0	34,205		31,574		41,456		46,255	
TOTAL	13,142	11,530	38,112	41,772	36,910	39,360	44,037	48,876	50,342	57,876

[a] YEARS SINCE RECEIPT OF BACCALAUREATE.
[b] NUMBER OF INCUMBENTS.
[c] FROM DMDC; 89 JOB CODES FROM CHART I-1.
[d] FROM DoE (REF. 22).

CHART VIII-34. CY-1987 SALARIES OF ALL NONSUPERVISORY S&E AT THE MASTER'S DEGREE LEVEL

MATURITY [a]	N [b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
	DoD [c]	DoE [d]	DoD	DoE	DoD	DoE	DoD	DoE	DoD	DoE
0		21		34,284		34,416		37,140		40,092
1	1	35	29,197	35,328	29,197	35,328	29,197	36,684	29,197	39,612
2	18	101	29,046	34,992	29,197	34,968	31,383	37,416	32,346	38,880
3	56	186	30,666	35,328	31,383	35,448	32,288	37,656	33,993	40,476
4	74	208	30,849	36,528	31,383	36,720	33,194	39,720	34,739	42,732
5	108	211	32,374	38,172	33,194	38,136	34,739	41,436	36,885	44,136
6	117	210	33,026	39,396	33,653	39,168	35,824	42,564	38,000	45,012
7	114	217	34,437	40,644	34,739	41,088	38,014	44,616	40,219	48,108
8	136	233	35,471	41,220	35,655	40,848	38,727	45,852	40,583	49,320
9	118	215	35,285	42,288	35,824	42,396	38,727	45,876	41,308	49,872
10	148	211	35,793	42,912	36,910	42,396	40,018	47,304	42,038	51,600
11	149	218	36,600	44,820	36,910	44,268	40,220	49,344	42,599	53,976
12	136	197	37,521	45,780	37,996	45,792	41,401	50,988	43,245	55,272
13	143	188	39,476	46,740	40,272	46,212	42,599	52,212	45,530	56,880
14	135	184	39,145	46,596	40,167	46,332	42,792	51,252	46,471	56,688
15	176	168	40,342	47,664	41,401	46,716	43,794	52,692	47,304	57,732
16	187	154	40,692	48,156	41,308	47,808	44,323	52,944	47,720	58,836
17	195	135	42,422	49,824	42,599	49,308	45,180	55,264	49,986	61,512
18	230	117	43,497	51,228	43,137	51,168	46,589	56,964	50,342	64,392
19	194	119	43,835	52,620	43,815	52,980	46,471	57,864	51,136	63,276
20	193	138	44,772	55,344	44,232	55,608	47,391	60,696	51,796	64,296
21	237	120	45,648	53,568	45,180	54,012	50,114	59,412	54,882	64,008
22-23	455	224	46,468	54,864	45,595	54,504	50,321	59,844	55,396	65,856
24-25	358	200	47,793	56,160	48,043	56,796	51,987	61,968	56,448	67,008
26-27	346	225	48,470	56,256	49,052	57,048	53,390	63,348	58,380	68,172
28-29	292	182	50,111	58,452	50,342	58,872	56,365	64,980	61,315	70,572
30-31	255	153	50,240	57,960	50,342	58,272	54,915	64,320	59,492	71,052
32-33	231	160	50,355	57,792	50,342	56,712	56,441	63,612	59,492	71,412
34-35	185	168	48,719	57,852	49,563	58,212	50,773	65,112	59,492	71,172
36-40	282	267	49,081	59,760	50,342	60,384	50,342	66,528	59,492	71,928
41-50	133	64	49,363	58,452	50,342	60,612	58,167	65,412	65,714	73,572
>50	2	0	45,476		45,476		49,052		49,052	
ALL	5,404	5,229	43,702	48,108	43,424	46,584	49,994	55,980	55,170	63,552

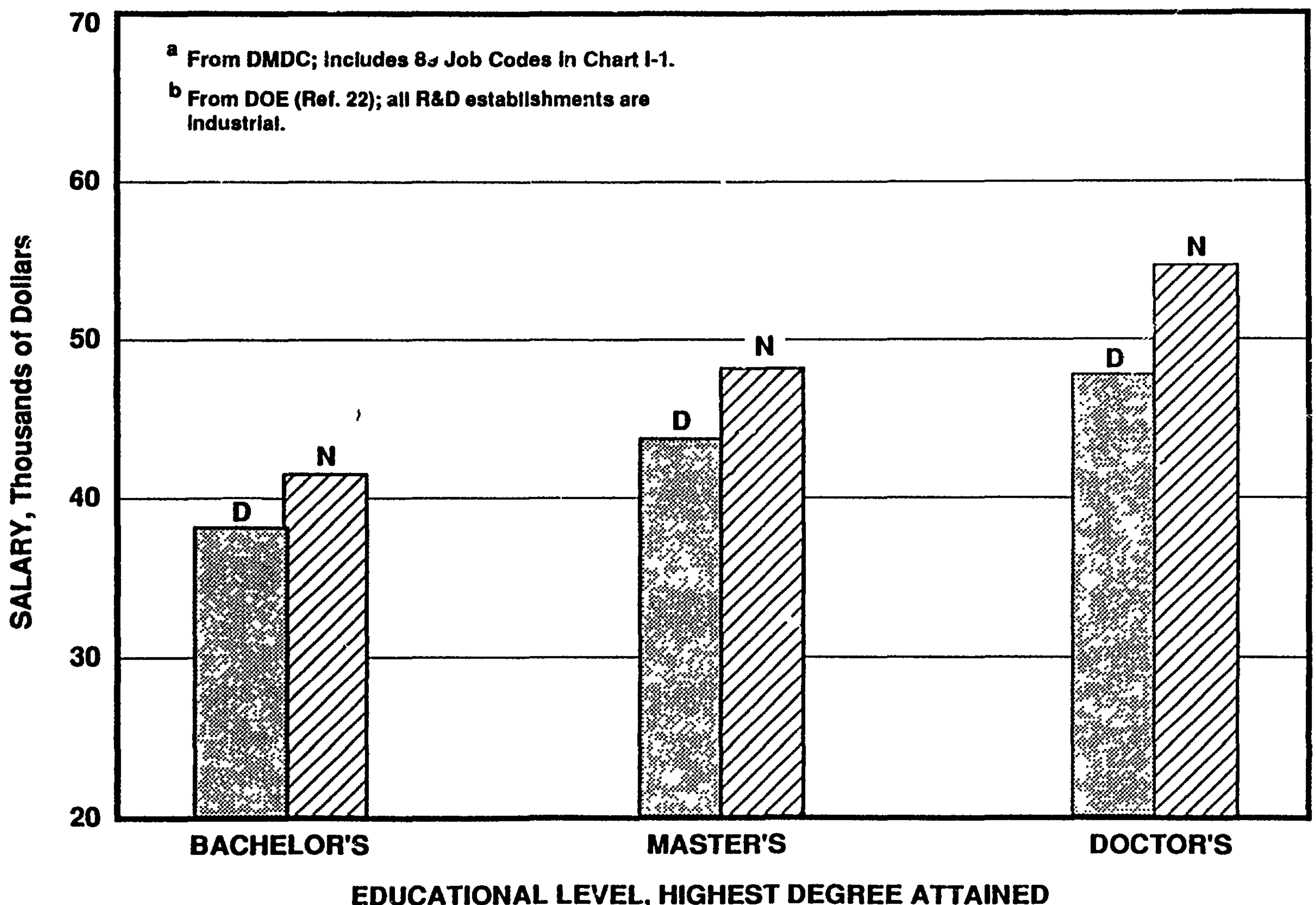
[a] YEARS SINCE RECEIPT OF BACCALAUREATE.
[b] NUMBER OF INCUMBENTS.
[c] FROM DMDC; 89 JOB CODES FROM CHART I-1.
[d] FROM DoE (REF. 22).

CHART VIII-35. CY-1987 SALARIES OF ALL NONSUPERVISORY S&E AT THE DOCTOR'S DEGREE LEVEL

	N[b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
MATURITY[a]	DoD[c]	DoE[d]	DoD	DoE	DoD	DoE	DoD	DoE	DoD	DoE
0										
1										
2										
3		7		39,708		39,612		42,912		
4	2	25	33,111	40,704	33,111	40,092	33,653	42,552	33,653	44,412
5	3	54	36,113	41,304	37,043	40,812	38,727	44,112	38,727	45,876
6	17	111	36,143	41,808	35,824	41,232	38,431	43,848	42,186	46,068
7	21	142	36,690	42,768	35,824	42,456	40,636	45,312	42,585	47,976
8	32	186	37,431	43,812	38,797	43,428	42,338	46,632	42,578	51,108
9	46	177	37,423	44,388	37,996	43,944	40,167	47,208	42,338	52,260
10	74	206	36,940	46,548	36,910	45,684	41,267	50,040	42,638	53,820
11	62	227	37,883	47,748	38,707	47,028	41,155	51,552	42,654	55,056
12	68	223	39,235	48,948	39,081	48,384	42,599	53,136	46,515	56,784
13	53	197	39,587	51,024	39,081	50,148	42,422	55,452	45,855	59,676
14	77	206	39,855	52,080	39,081	51,540	43,672	56,952	48,814	61,488
15	83	196	42,396	51,492	42,599	51,216	45,763	57,012	51,151	62,268
16	82	165	42,728	53,400	42,599	52,464	47,659	58,092	51,378	64,416
17	108	167	42,712	55,260	42,599	54,648	45,180	61,680	50,065	66,444
18	105	144	44,931	55,980	43,889	56,712	50,339	62,412	53,669	67,692
19	103	149	44,531	57,624	43,029	57,744	49,052	62,580	53,681	70,716
20	117	135	46,584	59,364	45,575	57,828	51,800	65,004	54,984	72,912
21	116	135	46,055	59,844	45,550	59,064	50,339	64,584	56,441	72,012
22-23	248	269	47,823	62,232	47,473	61,260	53,386	68,436	57,574	74,856
24-25	227	245	50,846	62,520	50,342	62,016	56,320	68,388	61,035	75,108
26-27	221	196	50,429	62,232	50,342	61,704	56,441	67,512	62,529	74,400
28-29	195	169	52,135	65,076	50,342	62,628	58,432	71,364	64,082	80,472
30-31	118	147	52,351	63,588	50,342	61,932	59,492	69,744	65,714	76,908
32-33	130	145	54,462	64,800	55,822	63,912	60,031	71,040	68,379	79,968
34-35	117	97	55,246	66,672	55,063	65,616	59,492	74,868	67,314	85,536
36-40	172	164	55,396	63,072	57,322	61,704	62,047	70,212	69,691	76,092
41-50	98	55	55,165	62,508	54,713	62,868	65,714	69,312	69,978	76,512
>50	5	0	53,752		50,342		62,325		65,158	
ALL	2,700	4,339	47,691	54,732	46,471	53,472	53,928	61,836	59,631	70,308

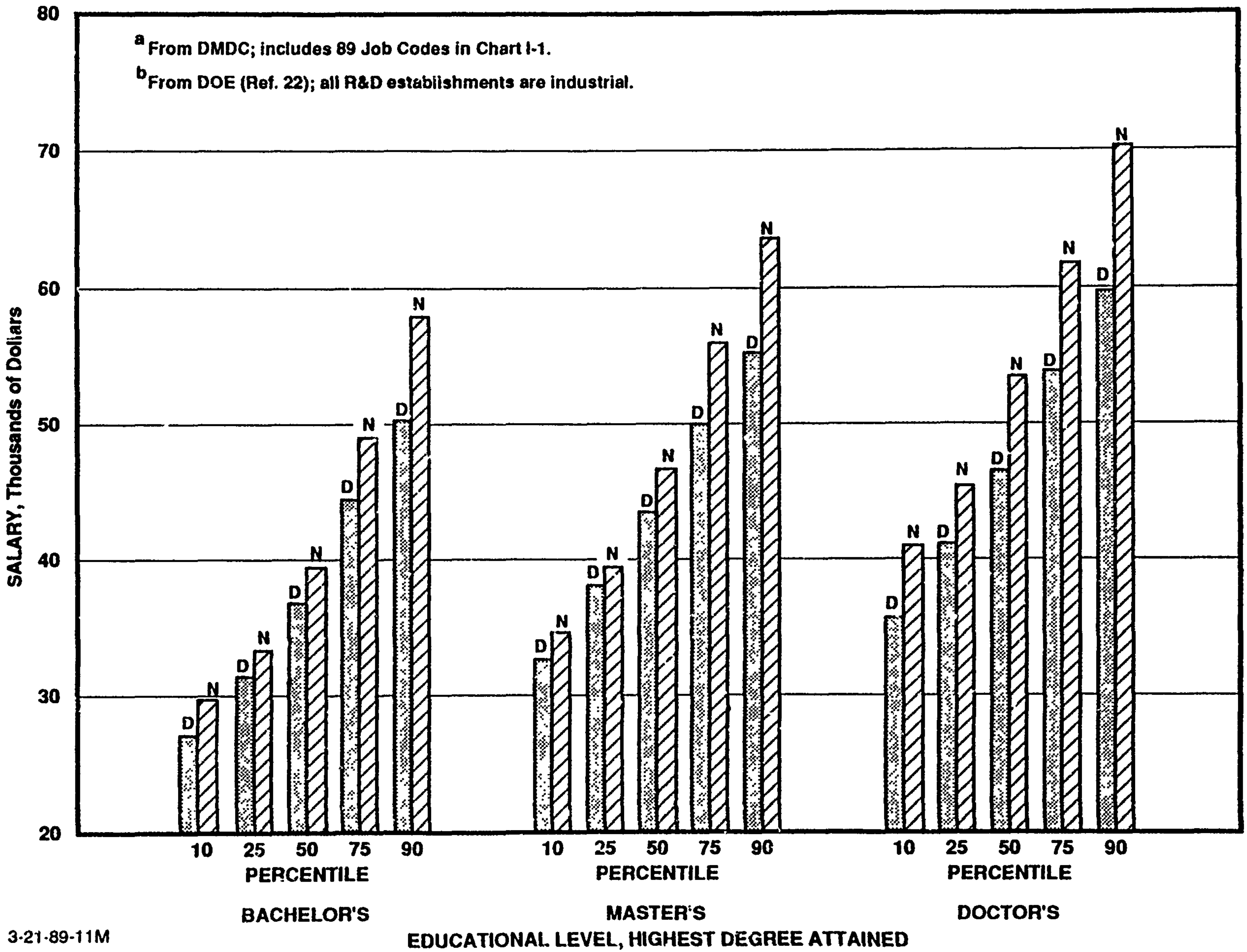
[a] YEARS SINCE RECEIPT OF BACCALAUREATE.
[b] NUMBER OF INCUMBENTS.
[c] FROM DMDC; 89 JOB CODES FROM CHART I-1.
[d] FROM DoE (REF. 22).

CHART VIII-36. COMPARISON OF AVERAGE SALARIES IN CY 1987 OF NONSUPERVISORY S&E IN DoD LABS (D)[a] AND NATIONAL R&D ESTABLISHMENTS (N)[b] FOR THREE EDUCATIONAL LEVELS



3-21-89-6M

CHART VIII ?7. COMPARISON OF PERCENTILE SALARIES IN CY 1987 OF NON-SUPERVISORY S&E IN DoD LABS (D)[a] AND NATIONAL R&D ESTABLISHMENTS (N)[b] FOR THREE EDUCATIONAL LEVELS



3-21-89-11M

CHART VIII-38. CY-1987 SALARIES OF NONSUPERVISORY CHEMISTS AT THE BACHELOR'S DEGREE LEVEL

MATURITY [a]	N [b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
	DoD [c]	DoE [d]	DoD	DoE	DoD	DoE	DoD	DoE	DoD	DoE
0	2	48	20,138	22,320	20,138	23,208	25,453	24,612	25,453	28,452
1	4	61	23,183	22,464	18,665	22,512	32,525	25,164	37,043	27,588
2	10	86	24,448	24,468	22,833	24,012	28,521	37,792	40,384	32,088
3	8	92	25,711	27,324	25,030	27,336	30,359	31,812	32,568	33,492
4	9	70	27,293	28,440	27,172	28,812	28,531	33,444	32,568	35,412
5	13	97	30,913	31,008	32,568	30,864	33,111	35,376	34,739	37,932
6	23	81	31,572	34,224	32,568	34,368	33,653	39,540	35,390	45,372
7	12	88	31,653	34,752	32,568	35,112	35,100	39,672	36,266	45,492
8	8	73	30,781	36,156	32,568	36,768	33,382	41,352	36,435	45,528
9	6	63	35,419	36,552	35,363	37,116	39,315	42,912	40,018	45,528
10	5	57	28,434	38,208	24,889	38,928	35,791	43,716	42,599	46,044
11	5	67	37,138	39,048	36,910	41,112	39,652	45,204	41,308	47,004
12	10	69	32,829	38,880	34,196	40,968	36,910	43,788	36,910	45,756
13	6	48	29,739	39,744	29,436	40,812	35,282	44,208	36,910	46,572
14	7	49	35,863	42,384	35,824	43,512	37,996	46,020	41,308	54,732
15	4	34	35,969	43,044	37,453	44,412	38,810	47,712	39,081	61,332
16	8	45	40,063	43,080	36,910	42,732	48,084	46,668	51,865	59,112
17	8	32	36,380	44,916	37,453	44,616	42,041	52,212	43,889	60,372
18	10	36	40,218	46,776	38,539	45,312	44,857	54,012	48,709	63,492
19	11	28	36,614	49,020	36,910	49,812	40,167	58,212	45,890	60,732
20	4	21	32,472	44,472	33,762	44,112	36,639	51,912	36,910	59,292
21	9	34	40,154	46,632	39,081	45,012	46,471	56,712	54,728	62,532
22-23	11	50	41,506	45,960	39,081	44,052	45,180	51,612	52,006	64,212
24-25	19	46	42,123	49,392	42,338	49,812	43,889	59,712	50,339	67,092
26-27	22	40	42,596	47,064	42,338	46,212	48,745	53,112	50,342	60,012
28-29	24	39	41,167	51,636	42,338	53,208	43,889	58,512	46,135	61,932
30-31	20	24	43,139	50,352	42,333	51,012	47,657	56,412	48,737	60,132
32-33	10	28	45,393	48,024	42,338	47,016	52,630	56,208	65,092	64,332
34-35	25	37	43,411	49,488	45,180	49,608	50,203	60,312	50,342	66,192
36-40	21	52	43,372	49,896	42,338	48,612	50,342	58,212	58,257	65,736
41-50	8	18	38,518	46,560	35,573	46,212	41,795	57,612	50,342	64,452
>50	0	0								
UNKNOWN	3	0	35,849		35,321		42,338		42,338	
ALL	345	1,613	37,227	37,812	36,910	37,032	42,338	46,320	48,898	55,176

[a] YEARS SINCE RECEIPT OF BACCALAUREATE.
[b] NUMBER OF INCUMBENTS.
[c] FROM DMDC; JOB CODE 1320.
[d] FROM DoE (REF. 22).

CHART VIII-39. CY-1987 SALARIES OF NONSUPERVISORY CHEMISTS AT THE MASTER'S DEGREE LEVEL

MATURITY[a]	N[b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
	DoD[c]	DoE[d]	DoD	DoE	DoD	DoE	DoD	DoE	DoD	DoE
0		2								
1										
2		5		36,108		31,212				
3		17		27,540		29,712		31,440		33,192
4	1	21	24,566	27,516	24,566	27,912	24,566	30,312	24566	32,172
5	2	24	25,497	30,300	25,497	30,216	28,535	34,812	28535	36,972
6	3	16	31,493	35,484	32,568	36,612	34,739	40,212	34739	43,176
7	2	33	30,413	34,728	30,413	35,532	33,653	38,112	33653	43,452
8	5	38	30,478	37,728	33,653	38,616	36,910	41,292	39081	46,572
9	1	38	29,889	36,252	29,889	37,008	29,889	39,912	29889	42,132
10	3	34	32,700	37,680	33,653	38,412	33,653	40,812	33653	43,656
11	4	43	32,768	39,288	31,229	39,612	37,187	44,712	38727	48,432
12	9	33	35,298	39,096	34,739	39,312	39,625	45,312	42599	48,096
13	3	30	34,567	43,140	33,653	42,012	39,081	48,312	39081	58,212
14	3	37	35,463	41,160	34,739	43,068	37,996	45,912	37996	47,772
15	4	56	38,114	42,900	40,437	42,612	42,276	45,408	42599	52,692
16	2	22	36,910	45,696	36,910	44,412	39,081	46,812	39081	59,172
17	5	27	35,444	45,816	35,824	46,416	39,016	51,168	41122	53,772
18	4	25	33,756	47,616	36,367	46,512	38,538	55,512	39081	64,812
19	5	19	40,622	45,876	40,018	44,412	45,180	51,168	46471	57,132
20	0	23		46,632		45,612		57,108		59,052
21	5	17	41,058	49,980	44,849	48,012	45,980	59,112	46471	63,372
22-23	12	32	41,240	50,136	41,796	48,612	43,674	56,412	53917	60,372
24-25	8	33	41,005	52,104	40,167	51,612	47,361	60,312	54979	66,432
26-27	10	34	44,863	48,700	43,889	47,412	48,084	57,312	49052	62,772
28-29	4	19	41,524	48,816	42,338	45,612	42,338	54,912	42338	66,732
30-31	10	16	47,497	51,204	50,342	49,212	54,324	58,812	59034	74,292
32-33	12	30	43,786	50,280	43,759	53,808	50,020	57,612	54611	62,412
34-35	12	33	43,716	52,452	42,338	51,312	50,342	59,316	62017	68,652
36-40	18	28	45,888	52,104	50,342	52,212	50,342	63,012	56719	67,332
41-50	13	10	46,371	51,396	44,937	55,212	50,342	63,312	63225	67,212
ALL	160	775	40,678	43,008	40,167	42,120	46,226	48,528	50342	58,764

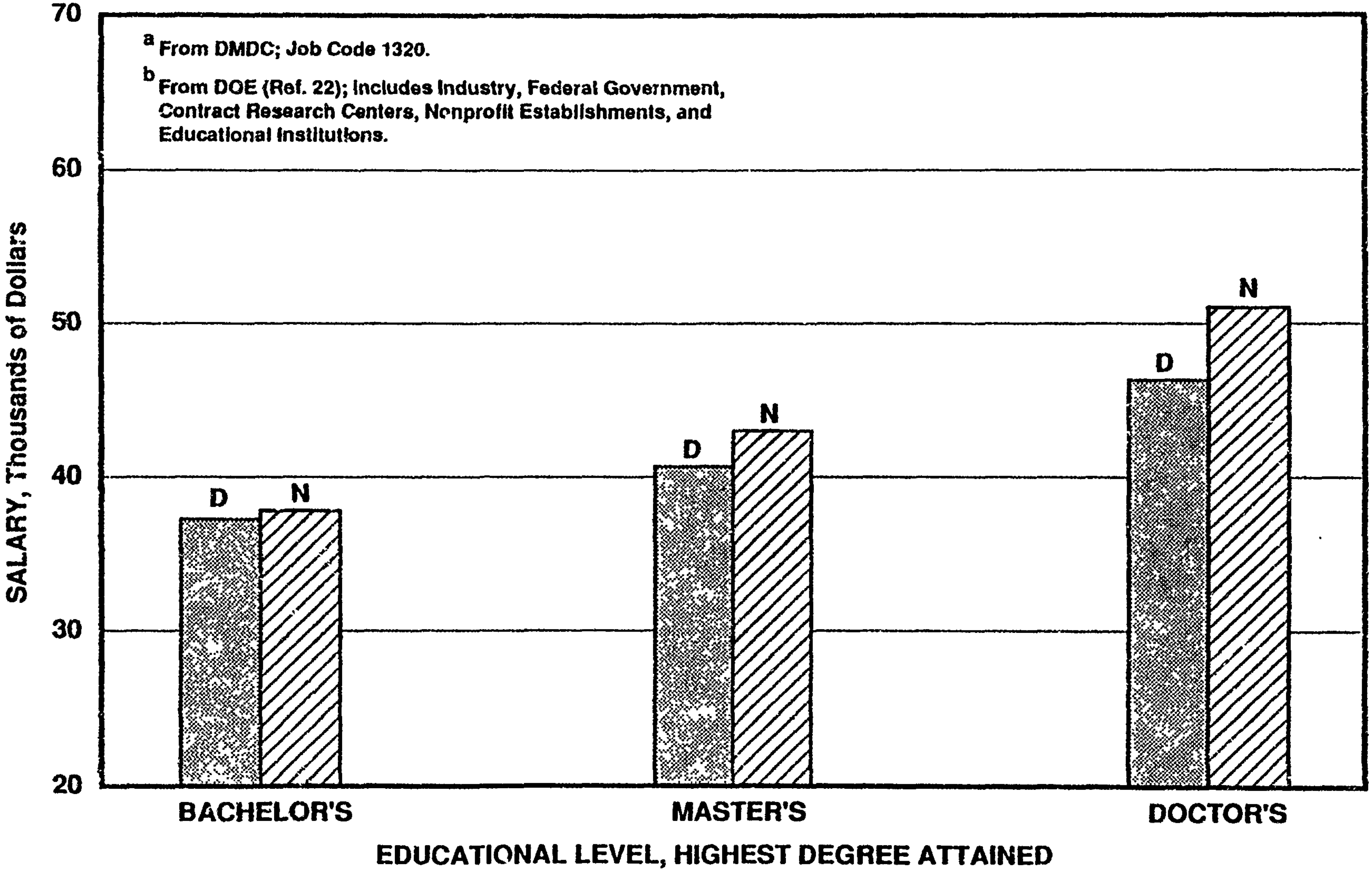
[a] YEARS SINCE RECEIPT OF BACCALAUREATE.
[b] NUMBER OF INCUMBENTS.
[c] FROM DMDC; JOB CODE 1320.
[d] FROM DoE (REF. 22).

CHART VIII-40. CY-1987 SALARIES OF NONSUPERVISORY CHEMISTS AT THE DOCTOR'S DEGREE LEVEL

	N[b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
MATURITY[a]	DoD[c]	DoE[d]	DoD	DoE	DoD	DoE	DoD	DoE	DoD	DoE
0										
1										
2										
3		3		40,344						
4		11		38,292		38,412		39,312		41,292
5		27		38,460		38,172		40,308		42,972
6	4	57	36,059	39,444	34,666	39,768	39,625	41,280	41,253	43,536
7	6	82	35,522	40,164	34,123	40,116	37,343	42,360	41,899	45,252
8	8	95	39,304	40,680	39,517	40,812	42,228	43,440	42,599	44,868
9	14	97	38,916	41,928	38,797	42,252	41,566	44,736	43,759	46,524
10	14	110	37,312	43,476	37,453	43,296	39,202	45,828	41,178	48,408
11	11	115	37,339	44,820	36,910	44,604	40,018	48,144	42,341	52,512
12	9	92	39,683	46,092	38,727	45,684	41,178	50,016	56,938	54,804
13	12	90	39,925	46,980	40,570	45,924	42,464	50,412	52,169	55,512
14	6	58	40,345	49,056	39,007	48,612	46,526	55,692	48,814	58,872
15	13	77	40,198	47,508	37,996	46,812	43,831	52,392	51,573	57,528
16	11	64	41,917	49,212	42,599	48,852	46,565	55,812	49,247	60,048
17	15	74	41,609	52,428	41,308	50,772	45,180	58,368	48,841	62,772
18	4	59	37,373	52,236	35,825	50,412	41,661	58,992	43,245	67,932
19	5	55	41,791	55,236	42,599	55,668	44,714	61,584	45,180	66,312
20	15	49	44,954	57,444	44,008	56,412	45,826	65,040	58,248	72,732
21	13	37	42,909	54,252	41,308	55,212	47,985	60,516	55,663	64,008
22-23	28	93	43,605	60,408	41,808	59,844	51,484	68,340	55,169	75,852
24-25	22	90	48,022	60,888	45,484	59,928	54,915	67,212	58,839	76,608
26-27	26	71	46,949	61,476	43,734	61,932	54,324	69,984	59,492	74,952
28-29	26	55	52,870	64,632	50,342	61,668	59,007	73,968	64,685	86,412
30-31	14	67	52,149	60,696	50,342	59,316	53,965	69,684	63,828	74,736
32-33	23	53	52,719	62,628	50,342	61,212	59,492	68,868	68,888	80,652
34-35	20	47	54,564	62,400	50,342	61,512	59,492	70,716	69,970	76,992
36-40	29	74	56,024	62,172	58,034	61,812	59,492	69,168	69,978	75,972
41-50	23	23	52,981	58,656	50,342	60,312	59,492	66,168	69,582	69,696
>50	3	0	55,281		50,342		65,158		65,158	
ALL	374	1,825	46,369	51,084	44,085	47,700	51,497	58,620	59,492	68,448

[a] YEARS SINCE RECEIPT OF BACCALAUREATE.
[b] NUMBER OF INCUMBENTS.
[c] FROM DMDC; JOB CODE 1320.
[d] FROM DoE (REF. 22).

CHART VIII-41. COMPARISON OF AVERAGE SALARIES IN CY 1987 OF NONSUPERVISORY CHEMISTS IN DoD LABS (D)[a] AND NATIONAL R&D ESTABLISHMENTS (N)[b] FOR THREE EDUCATIONAL LEVELS

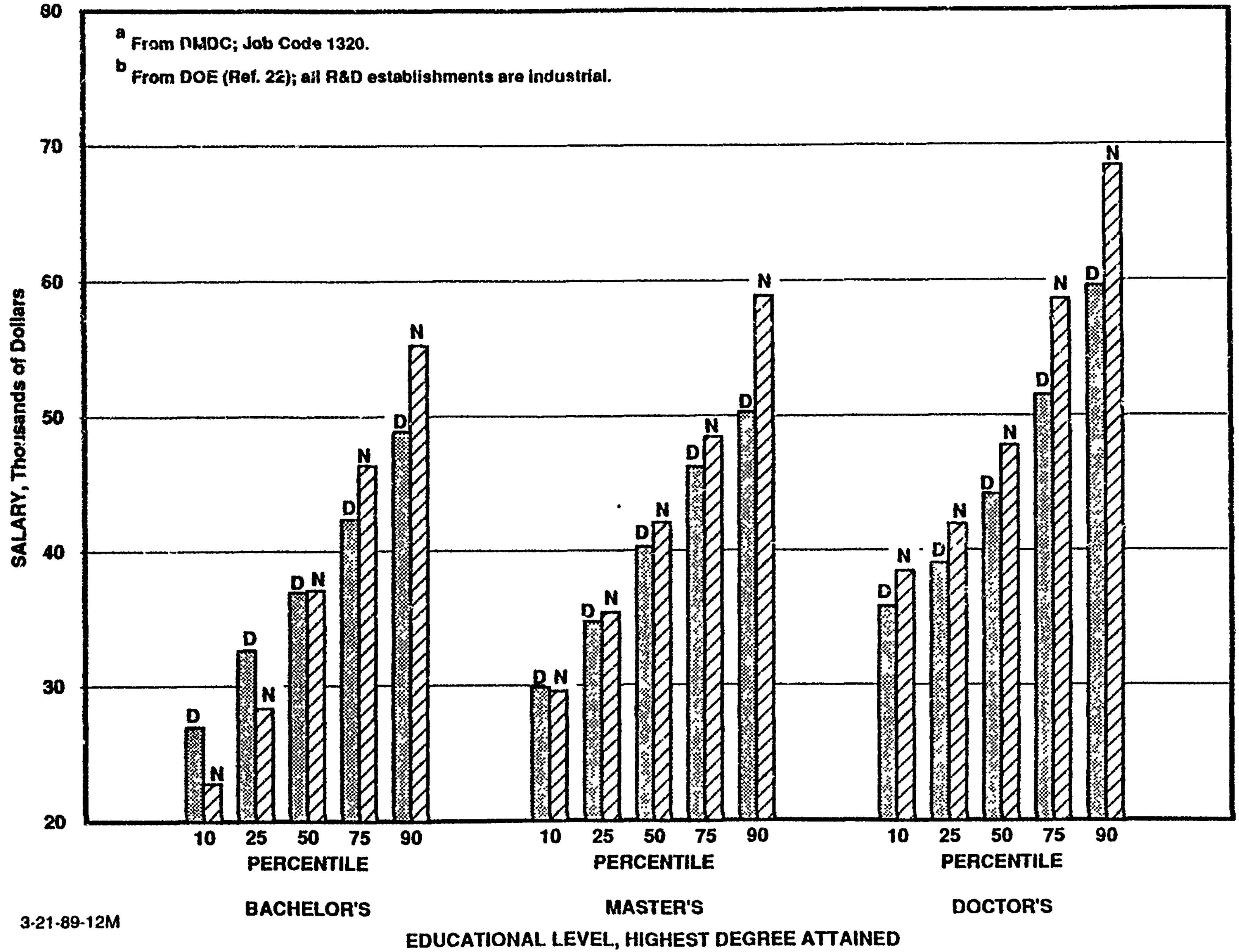


[a] From DMDC; Job Code 1320.

[b] From DOE (Ref. 22); Includes Industry, Federal Government, Contract Research Centers, Nonprofit Establishments, and Educational Institutions.

3-21-89-7M

CHART VIII-42. COMPARISON OF PERCENTILE SALARIES IN CY 1987 OF NON-SUPERVISORY CHEMISTS IN DoD LABS (D)[a] AND NATIONAL R&D ESTABLISHMENTS (N)[b] FOR THREE EDUCATIONAL LEVELS



3-21-89-12M

CHART VIII-43. CY-1987 SALARIES OF NONSUPERVISORY PHYSICISTS AT THE BACHELOR'S DEGREE LEVEL

	N[b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
MATURITY[a]	DoD[c]	DoE[d]	DoD	DoE	DoD	DoE	DoD	DoE	DoD	DoE
0	6	17	19,763	25,152	18,359	26,112	20,464	27,840	26,780	30,792
1	32	31	23,084	27,948	25,008	27,372	25,837	30,312	26,408	31,392
2	28	41	25,955	29,460	27,172	29,040	27,978	31,764	28,596	35,952
3	40	31	26,970	28,740	27,699	28,368	28,983	32,184	30,848	34,752
4	30	26	27,399	33,120	28,078	33,180	28,983	34,512	29,996	39,492
5	24	28	30,519	32,796	29,787	31,608	33,653	34,212	35,030	41,532
6	17	20	32,885	33,924	32,568	33,816	34,677	36,912	39,233	37,812
7	18	25	31,665	36,864	32,568	37,452	36,371	40,668	39,041	44,412
8	7	22	36,442	36,372	35,824	37,008	38,866	40,512	41,122	43,572
9	7	14	36,671	41,400	36,456	40,812	38,011	46,312	40,018	48,132
10	6	13	34,326	40,824	33,179	39,612	39,269	48,312	39,834	50,832
11	13	13	35,702	38,952	35,824	38,412	40,344	43,668	42,061	48,252
12	16	18	39,735	43,068	38,847	42,612	43,525	47,712	47,622	51,252
13	11	9	38,881	37,524	37,996	36,312	46,864	40,668	48,460	
14	14	13	42,011	43,968	40,167	42,408	48,656	49,512	53,660	54,252
15	10	11	40,667	43,236	42,599	42,012	44,185	47,712	47,206	53,292
16	16	10	38,941	41,628	38,539	40,212	42,534	45,312	45,310	54,012
17	19	11	44,172	48,432	43,245	47,208	48,362	52,512	50,342	55,692
18	21	16	46,101	47,520	46,061	48,612	50,342	51,012	56,496	59,652
19	19	12	45,558	50,532	45,304	49,812	48,335	57,012	53,363	61,572
20	20	16	44,054	49,632	44,547	50,052	48,120	51,612	50,342	56,052
21	27	6	45,163	52,632	44,232	53,412	47,761	54,312	54,655	
22-23	37	30	45,506	53,316	43,889	54,612	50,342	59,712	55,220	63,012
24-25	62	23	45,830	50,688	45,066	48,912	49,842	56,316	50,342	59,832
26-27	58	31	48,229	51,360	48,388	50,172	50,342	56,112	58,326	64,092
28-29	53	29	48,502	52,560	50,342	52,812	50,342	59,112	59,492	63,132
30-31	30	27	48,718	52,704	50,342	54,912	50,342	59,508	58,779	63,372
32-33	17	28	51,883	55,380	50,342	51,816	53,999	60,612	64,112	68,052
34-35	20	23	49,879	53,472	50,342	52,812	55,741	61,968	65,537	68,832
36-40	22	32	51,124	56,076	50,342	56,208	57,212	61,212	65,434	67,572
41-50	1	4	48,643	59,652	48,643	57,012	48,643		48,643	
>50	1	0	59,492		59,492		59,492		59,492	
UNKNOWN	3	0	26,327		25,451		28,078		28,078	
ALL	705	630	40,467	42,684	42,338	41,952	49,052	50,964	50,342	59,412

a YEARS SINCE RECEIPT OF BACCALAUREATE.
b NUMBER OF INCUMBENTS.
c FROM DMDC; JOB CODE 1310
d FROM DoE (REF. 22).

CHART VIII-44. CY-1987 SALARIES OF NONSUPERVISORY PHYSICISTS AT THE MASTER'S DEGREE LEVEL

MATURITY [a]	N [b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
	DoD [c]	DoE [d]	DoD	DoE	DoD	DoE	DoD	DoE	DoD	DoE
0		1								
1		2								
2		4		27,492		26,412				
3	2	12	30,794	32,796	30,794	33,252	33,510	33,972	33,510	35,172
4	5	9	26,372	35,940	27,172	35,712	29,512	37,512	30,472	
5	9	12	30,211	35,700	31,451	35,016	33,653	39,612	33,653	41,172
6	12	22	30,705	35,952	30,880	35,412	32,816	38,112	33,636	40,092
7	7	14	31,254	37,488	32,181	36,912	34,739	38,412	36,910	49,332
8	7	23	32,949	40,476	33,653	41,112	35,824	43,908	35,824	47,052
9	9	13	35,062	43,236	35,824	42,312	38,727	45,912	45,763	51,852
10	15	17	35,665	40,404	35,824	39,612	41,122	43,512	41,576	47,136
11	16	20	36,948	40,668	36,367	38,712	42,042	44,412	45,355	48,012
12	6	23	32,836	44,028	29,436	43,512	41,122	46,512	43,455	52,032
13	11	15	35,947	47,316	34,748	46,812	40,344	53,712	42,547	60,012
14	12	22	38,022	43,668	37,453	42,612	39,784	45,612	43,256	50,772
15	10	18	40,434	47,400	40,071	47,808	43,884	50,016	47,189	53,652
16	13	14	39,127	48,096	41,122	48,012	43,109	56,412	49,269	58,932
17	14	17	41,764	43,788	40,093	43,512	47,711	48,312	51,173	49,536
18	18	17	43,181	50,388	41,954	50,412	47,805	56,268	50,497	60,972
19	13	17	41,105	50,880	42,452	50,268	48,300	53,268	50,252	59,772
20	19	11	46,527	53,376	45,180	50,412	50,342	60,168	54,615	62,892
21	20	17	44,462	49,236	43,889	47,268	49,787	53,868	52,699	60,972
22-23	62	30	46,305	53,976	45,574	54,612	49,335	59,112	53,747	65,412
24-25	37	28	49,019	52,680	49,052	54,612	54,107	59,808	58,538	61,272
26-27	52	30	47,148	55,488	48,170	54,612	52,608	62,016	56,531	65,412
28-29	34	32	50,176	55,044	50,009	55,212	55,087	58,212	60,467	68,772
30-31	30	21	50,382	53,400	50,341	50,892	55,297	57,912	59,339	64,092
32-33	37	23	51,926	57,840	50,342	52,812	56,456	66,912	60,665	77,052
34-35	25	13	50,007	53,244	50,342	50,892	53,363	56,712	59,808	63,852
36-40	36	35	51,796	57,180	50,342	56,412	57,936	65,568	59,492	70,812
41-50	15	5	55,591	55,668	50,342	54,012	64,242		68,779	
ALL	546	537	45,018	47,868	45,180	47,148	50,342	55,284	56,450	61,848

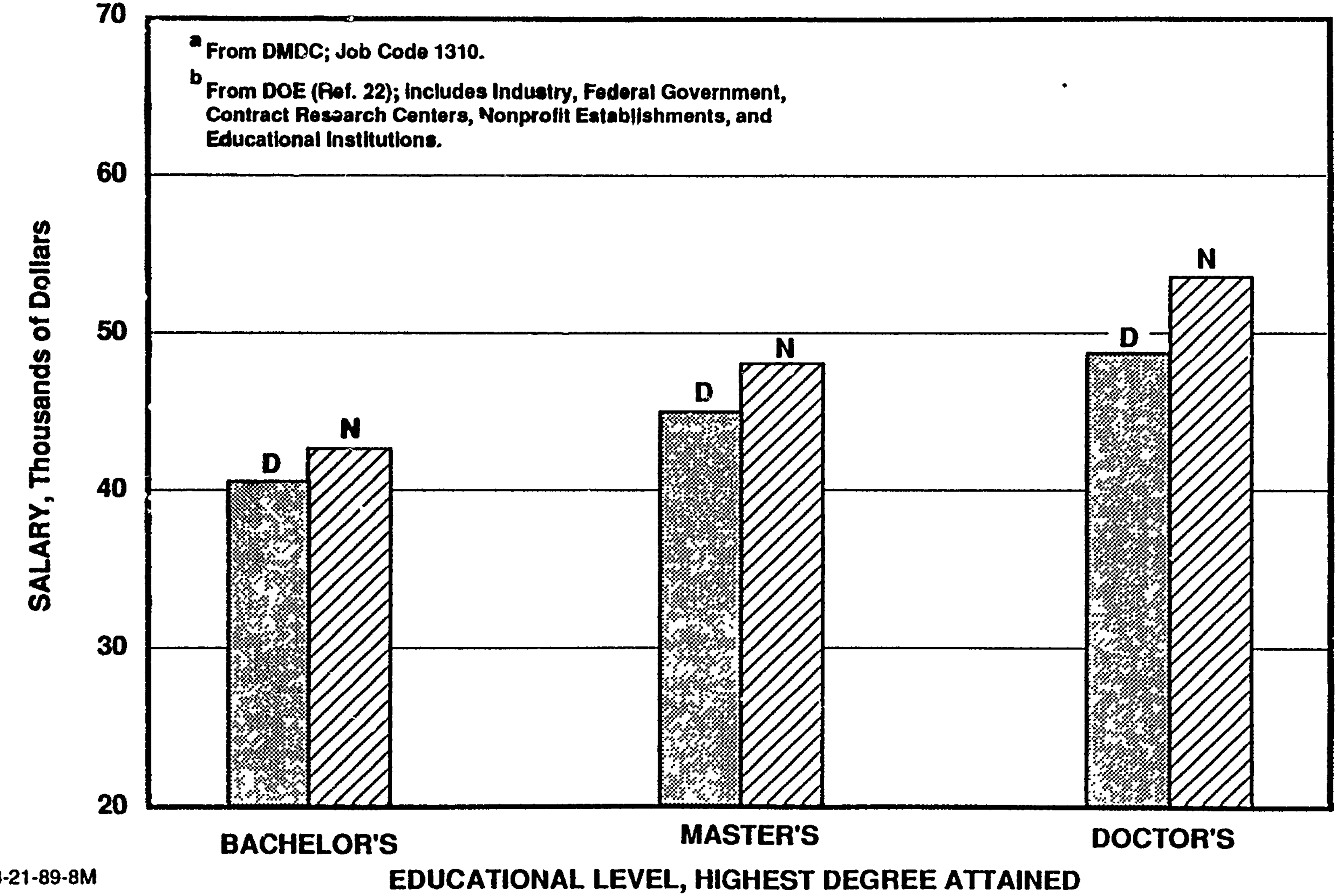
[a] YEARS SINCE RECEIPT OF BACCALAUREATE.
[b] NUMBER OF INCUMBENTS.
[c] FROM DMDC; JOB CODE 1310
[d] FROM DoE (REF. 22).

CHART VIII-45. CY-1987 SALARIES OF NONSUPERVISORY PHYSICISTS AT THE DOCTOR'S DEGREE LEVEL

	N[b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
MATURITY[a]	DoD[c]	DoE[d]	DoD	DoE	DoD	DoE	DoD	DoE	DoD	DoE
0										
1										
2										
3		2								
4		4		37,680		42,012				
5	2	10	37,885	35,484	37,885	37,212	38,727	44,412	38,727	45,612
6	5	17	36,476	38,268	36,910	40,812	37,996	47,112	37,996	51,372
7	5	38	34,175	39,504	33,653	41,892	35,502	46,008	36,411	51,492
8	9	28	38,237	43,560	39,081	46,212	42,338	52,212	42,338	53,652
9	11	35	38,441	40,692	38,648	42,012	40,167	47,952	42,132	50,712
10	25	46	36,409	44,412	37,996	49,416	42,338	53,268	44,405	56,052
11	18	40	38,633	46,416	39,081	46,212	41,253	51,972	42,622	55,812
12	20	60	40,173	48,996	40,636	50,052	42,599	53,808	46,472	60,012
13	18	43	39,921	49,680	38,464	50,172	43,063	55,116	47,773	59,832
14	23	52	41,612	50,676	41,308	51,408	45,180	56,412	49,873	61,092
15	26	52	43,797	51,252	43,371	53,412	46,059	57,612	50,988	62,292
16	19	53	45,681	51,144	44,854	50,112	50,339	55,440	59,492	60,252
17	34	49	43,998	54,492	42,814	54,816	45,664	61,140	50,745	65,532
18	33	47	44,823	53,328	43,294	53,712	49,577	58,284	52,857	62,736
19	31	43	43,808	57,300	42,520	57,612	48,059	64,512	51,818	71,232
20	27	50	46,503	56,592	46,471	56,616	50,414	60,972	59,637	69,612
21	40	40	46,093	57,468	46,312	56,112	51,330	63,012	54,762	67,812
22-23	66	89	48,684	58,248	47,472	57,372	52,430	63,468	60,054	71,532
24-25	66	64	51,677	56,928	51,865	57,012	55,956	64,512	59,988	68,856
26-27	60	61	51,588	57,156	50,342	56,112	56,743	61,512	63,180	68,892
28-29	65	35	51,480	61,068	50,342	58,968	56,809	67,368	59,980	70,812
30-31	40	35	53,321	60,756	52,614	59,712	59,492	64,512	65,423	72,912
32-33	35	51	56,882	62,844	58,554	63,612	64,483	67,632	69,071	74,976
34-35	42	35	56,230	64,032	58,819	62,412	59,492	70,716	67,446	79,212
36-40	45	60	59,006	64,368	59,492	61,812	65,714	72,012	69,978	77,412
41-50	26	18	58,928	62,712	59,492	61,212	66,435	66,012	69,978	81,252
ALL	791	1,157	48,619	53,700	47,523	53,580	54,915	60,492	61,227	68,352

a YEARS SINCE RECEIPT OF BACCALAUREATE.
b NUMBER OF INCUMBENTS.
c FROM DMDC; JOB CODE 1310
d FROM DoE (REF. 22).

CHART VIII-46. COMPARISON OF AVERAGE SALARIES IN CY 1987 OF NONSUPERVISORY PHYSICISTS IN DoD LABS (D)[a] AND NATIONAL R&D ESTABLISHMENTS (N)[b] FOR THREE EDUCATIONAL LEVELS

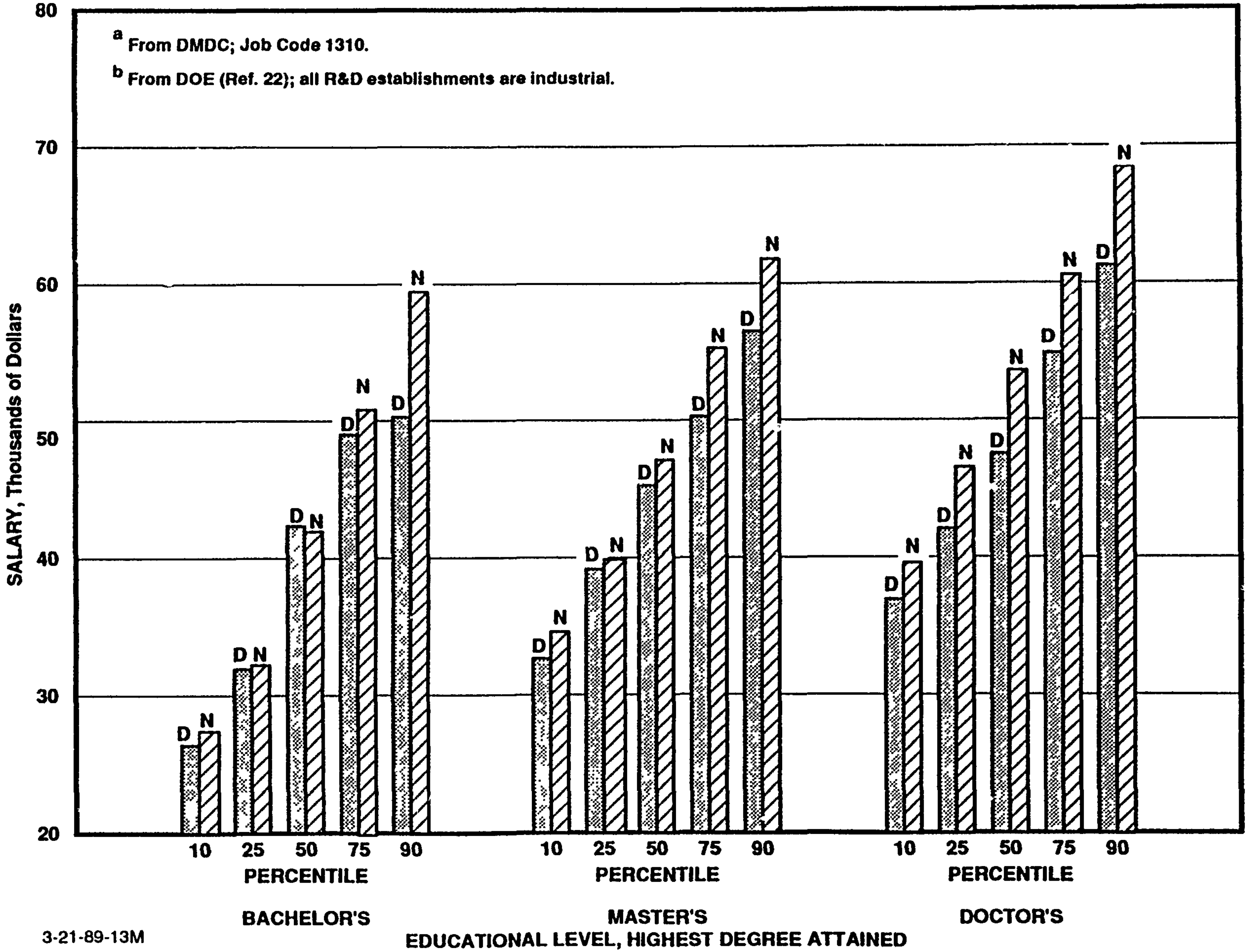


[a] From DMDC; Job Code 1310.

[b] From DOE (Ref. 22); includes Industry, Federal Government, Contract Research Centers, Nonprofit Establishments, and Educational Institutions.

3-21-89-8M

CHART VIII-47. COMPARISON OF PERCENTILE SALARIES IN CY 1987 OF NON-SUPERVISORY PHYSICISTS IN DoD LABS (D)[a] AND NATIONAL R&D ESTABLISHMENTS (N)[b] FOR THREE EDUCATIONAL LEVELS



3-21-89-13M

CHART VIII-48. CY-1987 SALARIES OF NONSUPERVISORY ELECTRICAL AND ELECTRONICS ENGINEERS AT THE BACHELOR'S DEGREE LEVEL

MATURITY [a]	N [b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
	DoD [c]	DoE [d]	DoD	DoE	DoD	DoE	DoD	DoE	DoD	DoE
0	129	294	23,714	30,108	23,865	30,240	23,865	31,476	28,325	32,772
1	465	459	27,475	30,696	29,197	30,708	29,197	31,812	29,946	33,612
2	361	482	29,955	32,568	29,946	32,484	31,863	33,948	31,863	35,856
3	406	421	32,770	33,780	31,863	33,516	35,756	35,340	35,756	37,632
4	246	323	34,803	35,760	35,756	35,640	36,885	37,860	38,014	40,140
5	172	306	36,449	37,476	36,885	37,308	38,014	39,528	39,143	42,852
6	148	260	37,924	39,588	38,014	39,420	39,143	42,144	41,141	45,012
7	95	216	38,498	40,848	39,143	40,152	40,272	43,488	42,558	47,988
8	87	147	39,366	41,736	40,272	41,196	41,308	45,336	42,770	48,384
9	74	119	40,680	42,876	40,272	42,108	42,599	46,104	44,104	52,224
10	88	109	41,206	43,500	41,308	42,192	43,103	47,040	45,180	53,052
11	75	101	41,398	44,412	41,401	43,908	43,675	49,272	44,861	53,388
12	101	86	41,955	44,544	41,401	44,340	43,889	48,708	46,360	52,692
13	86	63	42,695	46,704	42,686	46,296	44,597	50,784	46,471	56,088
14	139	83	43,233	45,828	42,599	45,432	45,180	50,568	47,288	54,528
15	126	73	43,794	47,208	43,008	46,812	45,648	51,672	48,786	55,452
16	73	79	43,804	46,908	43,273	47,316	45,180	50,784	48,093	57,048
17	72	66	44,510	49,800	43,889	50,016	46,888	55,968	50,342	61,452
18	80	74	44,863	51,168	44,489	50,268	47,674	56,808	50,216	62,856
19	71	54	45,432	51,444	44,787	52,608	47,738	56,808	51,654	63,372
20	76	44	47,344	52,008	45,916	50,712	50,311	58,212	53,687	63,492
21	95	57	47,187	50,616	46,471	51,216	49,052	56,940	53,516	61,392
22-23	187	83	48,137	52,596	47,622	50,592	50,342	56,712	55,679	61,728
24-25	178	116	48,534	54,060	48,168	53,412	50,342	59,652	54,318	66,252
26-27	183	152	48,882	54,408	49,052	54,408	50,342	59,712	57,433	65,124
28-29	150	137	49,610	54,372	50,341	53,040	50,342	60,060	57,966	65,124
30-31	64	91	49,746	54,960	50,342	54,768	54,349	61,344	59,492	65,688
32-33	45	81	48,698	55,140	50,062	55,116	50,342	60,240	55,414	65,292
34-35	54	98	50,455	56,988	50,341	56,532	51,288	63,912	60,772	68,748
36-40	83	165	48,504	54,924	49,801	55,284	50,342	61,512	58,971	67,512
41-50	25	39	47,727	53,988	45,916	53,616	50,342	58,512	63,686	63,132
>50	1	0	40,011		40,011		40,011		40,011	
UNKNOWN	17	0	37,085		35,756		44,599		53,808	
ALL	4,252	4,878	39,034	41,160	39,566	38,448	45,916	47,856	50,342	56,832

[a] YEARS SINCE RECEIPT OF BACCALAUREATE.
[b] NUMBER OF INCUMBENTS.
[c] FROM DMDC; JOB CODES 850 AND 855.
[d] FROM DoE (REF. 22).

CHART VIII-49. CY-1987 SALARIES OF NONSUPERVISORY ELECTRICAL AND ELECTRONICS ENGINEERS AT THE MASTER'S DEGREE LEVEL

MATURITY [a]	N [b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
	DoD [c]	DoE [d]	DoD	DoE	DoD	DoE	DoD	DoE	DoD	DoE
0		8		33,312		33,012		36,612		
1		25		35,928		36,492		37,476		38,412
2	7	71	29,011	36,720	29,197	37,044	29,946	39,408	31,863	40,884
3	7	84	32,024	37,536	31,863	34,812	33,674	40,128	33,674	41,532
4	13	103	33,169	38,652	32,017	38,508	35,756	40,632	40,330	42,948
5	21	107	35,587	39,948	35,756	39,504	37,099	43,176	44,561	46,044
6	17	117	36,100	41,916	36,390	41,364	38,014	44,796	40,498	48,804
7	27	108	37,945	43,752	38,014	43,416	40,272	46,932	42,078	50,820
8	29	100	38,380	44,544	38,014	44,484	40,145	48,780	44,787	50,892
9	20	98	36,625	44,424	37,450	44,160	41,339	49,140	42,986	53,172
10	32	91	38,684	45,612	40,272	45,432	42,530	49,152	42,599	53,688
11	35	79	39,371	47,124	40,272	47,268	42,530	52,032	44,033	56,076
12	34	85	40,331	48,816	41,355	48,816	42,761	53,940	45,916	56,784
13	51	90	41,169	48,612	42,530	49,416	43,029	53,292	45,763	56,808
14	39	78	42,524	47,988	42,530	47,412	45,916	52,812	47,288	57,096
15	56	82	42,762	49,512	42,599	49,212	44,838	54,312	47,868	57,336
16	46	69	42,250	49,440	42,565	50,172	44,860	54,072	48,141	59,448
17	74	76	44,850	51,960	44,459	52,380	47,328	56,292	50,342	59,892
18	76	66	44,206	51,852	43,685	52,812	46,471	57,768	49,569	63,168
19	52	80	45,235	54,336	44,141	55,368	46,249	58,416	50,922	63,012
20	69	78	46,205	56,148	45,180	55,212	48,811	60,732	52,177	63,088
21	80	52	45,838	54,336	45,180	54,612	48,814	60,216	54,130	65,292
22-23	145	142	47,371	55,248	45,916	55,908	50,341	62,016	55,083	66,240
24-25	113	111	50,290	55,704	49,634	55,884	54,915	60,660	59,390	66,492
26-27	87	135	50,188	57,372	50,342	55,644	54,915	62,928	59,492	67,212
28-29	92	105	51,888	58,812	50,342	58,284	55,531	64,668	65,556	70,812
30-31	75	82	51,198	58,896	50,342	58,812	56,511	64,812	61,467	69,972
32-33	60	72	50,899	58,992	50,450	58,212	54,522	65,412	62,470	71,172
34-35	56	81	48,125	59,052	47,861	59,484	50,342	66,516	55,607	74,172
36-40	71	148	48,985	58,776	48,519	58,560	50,342	64,728	57,637	70,452
41-50	21	27	49,231	57,744	50,342	59,712	59,492	64,512	69,123	71,772
>50	1	0	49,052		49,052		49,052		49,052	
ALL	1,506	2,650	45,750	49,896	45,169	49,152	50,339	56,664	55,078	63,576

[a] YEARS SINCE RECEIPT OF BACCALAUREATE.
[b] NUMBER OF INCUMBENTS.
[c] FROM DMDC; JOB CODES 850 AND 855.
[d] FROM DoE (REF. 22).

CHART VIII-50. CY-1987 SALARIES OF NONSUPERVISORY ELECTRICAL AND ELECTRONICS ENGINEERS AT THE DOCTOR'S DEGREE LEVEL

	N[b]		AVERAGE SALARY		PERCENTILE (P.) SALARY					
					50P		75P		90P	
MATURITY[a]	DoD[c]	DoE[d]	DoD	DoE	DoD	DoE	DoD	DoE	DoD	DoE
0										
1										
2										
3										
4		3		43,632						
5		3		42,276						
6	1	14	45,916	47,412	45,916	46,812	45,916	51,312	45,916	52,575
7	3	23	43,682	47,568	42,599	48,168	45,916	50,712	45,916	51,828
8	3	27	44,411	47,352	44,787	47,712	45,916	51,684	45,916	54,972
9	2	32	43,244	48,972	43,244	49,968	45,180	52,212	45,180	55,572
10	0	31		49,848		50,268		53,112		56,892
11	2	29	39,577	50,088	39,577	50,412	40,011	53,340	40,011	56,652
12	4	47	41,533	51,864	42,814	52,572	45,080	55,908	45,763	59,532
13	3	34	45,901	55,872	45,916	55,812	51,516	58,812	51,516	66,132
14	4	30	44,431	55,092	44,464	54,612	46,178	60,012	46,265	63,012
15	2	27	48,607	54,468	48,607	55,212	51,451	59,484	51,451	62,172
16	6	34	46,726	54,144	49,100	53,112	51,801	57,312	53,899	68,532
17	5	40	43,586	58,260	43,135	57,312	44,799	63,012	45,708	69,612
18	8	32	45,380	57,792	45,569	56,712	49,023	63,612	50,342	71,892
19	9	25	51,756	57,288	51,862	56,868	58,073	61,068	61,622	64,812
20	17	40	48,928	58,992	46,615	57,612	54,153	64,212	57,308	71,412
21	15	29	50,887	62,172	50,296	61,608	56,441	65,940	67,484	75,072
22-23	28	70	49,819	60,372	49,947	61,212	54,842	66,108	58,424	73,212
24-25	36	70	50,364	62,304	48,726	62,208	54,890	69,216	61,407	75,612
26-27	25	47	51,739	60,984	50,342	58,068	55,552	66,912	61,828	70,992
28-29	22	38	53,091	64,680	53,390	63,612	60,372	70,512	64,777	77,532
30-31	9	30	57,212	62,760	57,871	65,412	64,687	69,312	69,978	72,612
32-33	4	21	57,874	61,320	56,441	62,112	64,514	66,468	66,696	70,092
34-35	12	21	52,235	63,984	49,302	63,912	59,047	69,912	67,825	77,952
36-40	8	38	50,974	60,612	48,602	60,612	59,111	68,112	64,410	81,252
41-50	3	21	46,900	65,784	46,471	66,912	50,341	75,912	50,341	82,152
ALL	231	856	50,078	57,372	49,052	56,040	54,915	63,456	61,570	70,680

[a] YEARS SINCE RECEIPT OF BACCALAUREATE.
[b] NUMBER OF INCUMBENTS.
[c] FROM DMDC; JOB CODES 850 AND 855.
[d] FROM DoE (REF. 22).

CHART VIII-51. COMPARISON OF AVERAGE SALARIES IN CY 1987 OF NON-SUPERVISORY ELECTRICAL AND ELECTRONICS ENGINEERS IN DoD LABS (D)[a] AND NATIONAL R&D ESTABLISHMENTS (N)[b] FOR THREE EDUCATIONAL LEVELS

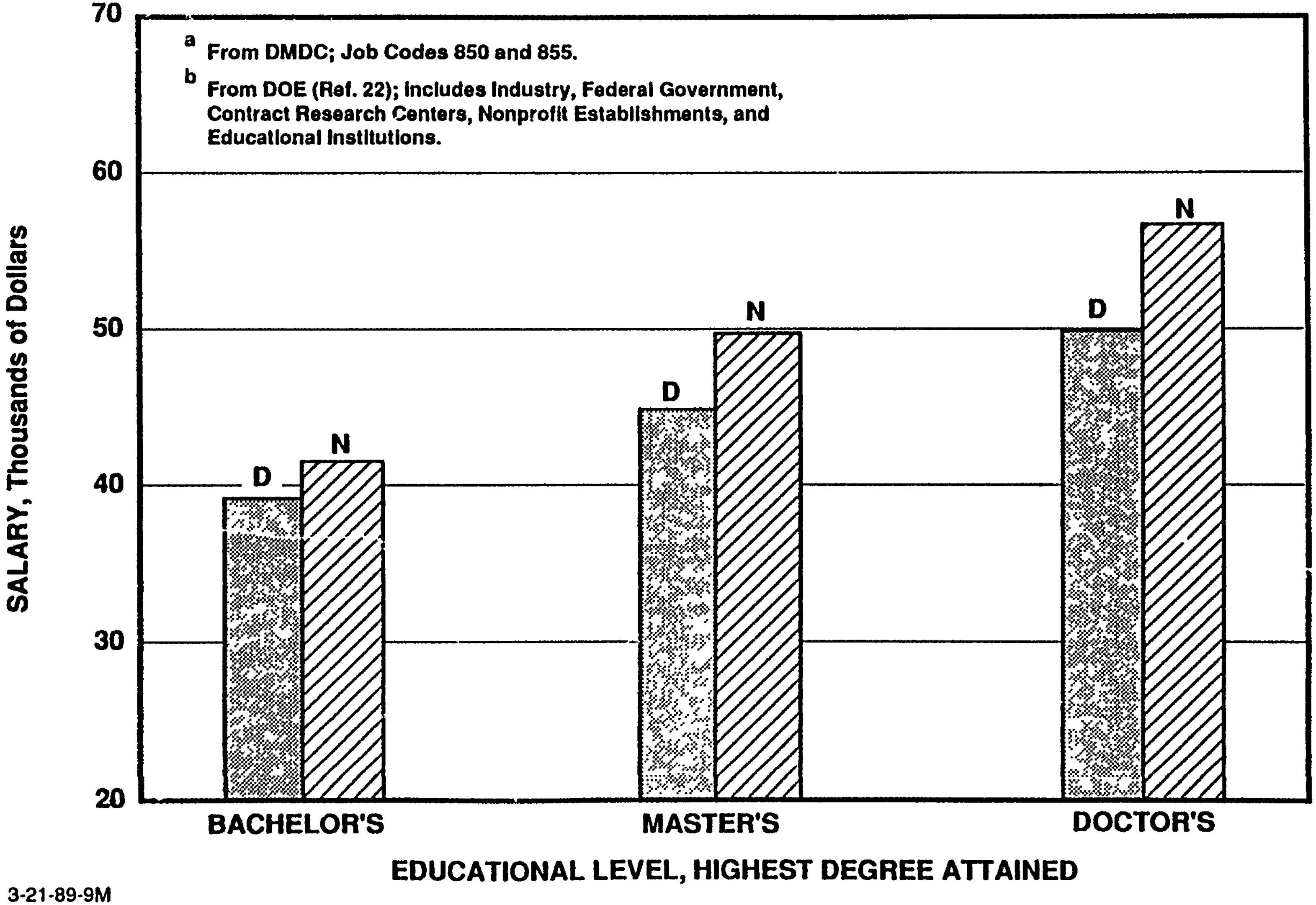
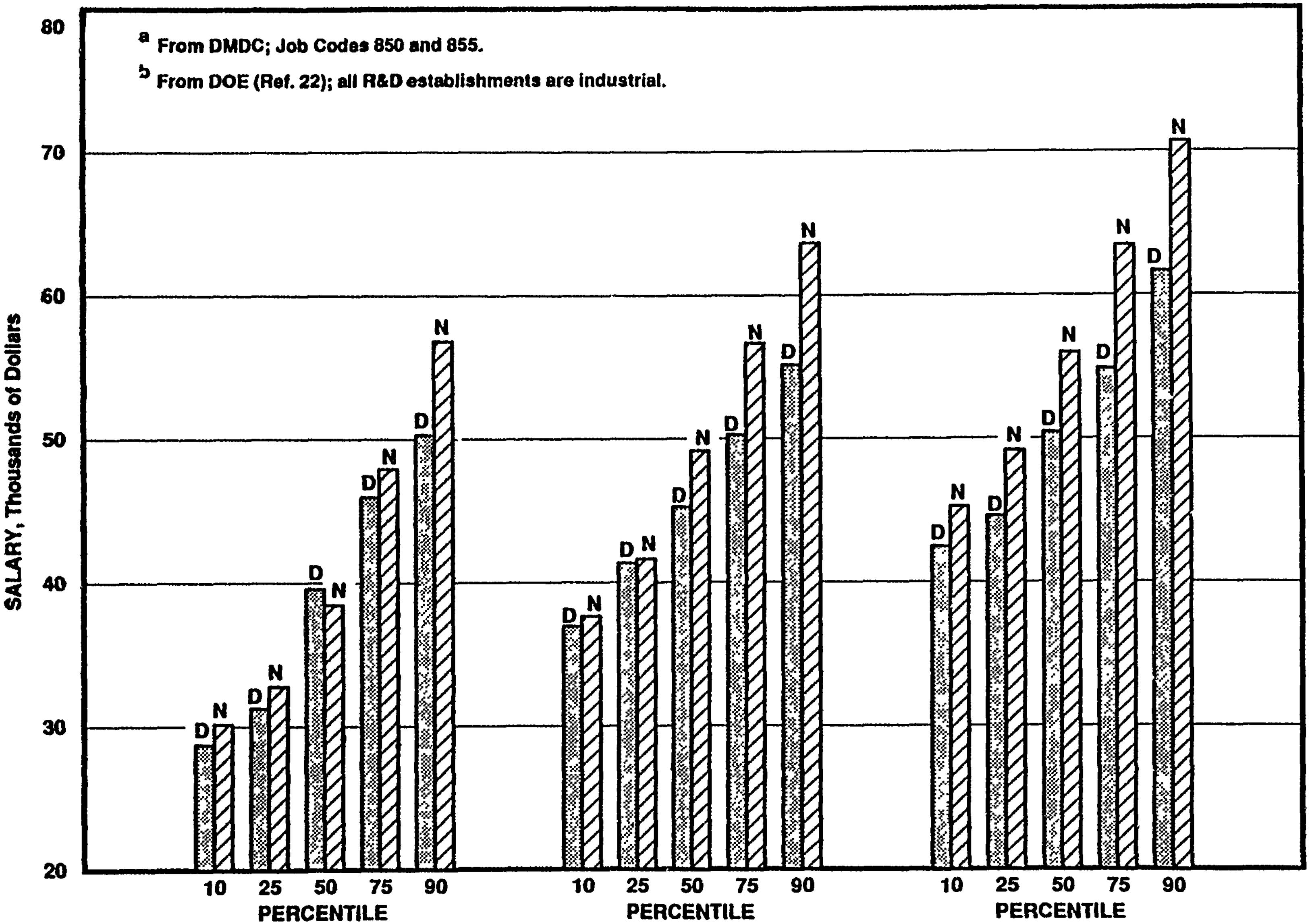


CHART VIII-52. COMPARISON OF PERCENTILE SALARIES IN CY 1987 OF NON-SUPERVISORY ELECTRICAL AND ELECTRONICS ENGINEERS IN DoD LABS (D)[a] AND NATIONAL R&D ESTABLISHMENTS (N)[b] FOR THREE EDUCATIONAL LEVELS



3-21-89-14M

CHART VIII-53. CY-1987 SALARIES OF NONSUPERVISORY MECHANICAL ENGINEERS AT THE BACHELOR'S DEGREE LEVEL

MATURITY [a]	N [b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
	DoD [c]	DoE [d]	DoD	DoE	DoD	DoE	DoD	DoE	DoD	DoE
0	50	68	24,391	29,772	23,865	28,968	23,865	30,480	29,197	32,772
1	253	108	27,628	29,952	29,197	30,132	29,197	31,980	29,946	32,904
2	282	91	29,827	30,780	29,946	30,648	31,383	32,436	32,288	34,788
3	318	105	31,974	32,520	31,804	32,124	33,194	33,984	34,739	36,408
4	180	101	33,270	33,864	33,653	33,672	34,739	35,712	35,824	38,280
5	119	89	34,631	36,564	34,739	36,384	35,824	38,880	36,910	41,196
6	96	87	36,101	38,952	35,824	39,216	36,910	42,312	38,215	45,132
7	62	110	36,645	39,348	36,910	38,928	38,000	42,948	41,019	45,312
8	57	89	38,204	41,015	37,996	41,484	40,093	44,592	42,599	46,248
9	37	87	38,098	42,936	37,996	42,684	40,093	46,248	42,390	48,468
10	33	49	37,990	41,760	37,996	41,532	40,093	45,912	42,083	48,672
11	45	30	39,917	43,980	39,793	44,208	41,308	48,408	43,889	54,612
12	45	40	38,897	44,016	39,081	43,812	40,182	48,312	43,455	51,012
13	36	42	41,190	47,088	41,253	47,208	43,728	51,312	47,034	56,484
14	32	40	40,810	45,288	40,826	45,816	43,889	50,412	47,110	53,412
15	52	38	41,457	46,920	41,253	46,608	43,743	50,808	48,104	53,652
16	35	36	42,061	49,152	41,253	48,216	44,966	52,692	47,795	56,292
17	49	30	42,118	49,464	41,308	48,612	43,889	51,216	47,826	59,412
18	38	53	42,943	49,536	42,469	49,368	44,966	54,468	47,955	60,252
19	29	38	44,339	51,204	43,424	51,612	46,471	59,532	54,127	60,972
20	33	37	45,273	52,116	45,180	50,712	46,537	55,512	51,519	58,572
21	32	20	44,491	51,960	43,424	51,612	43,915	55,416	50,342	60,012
22-23	85	57	45,215	50,652	44,320	50,268	48,116	54,552	50,342	58,572
24-25	80	48	46,162	52,452	45,788	51,816	50,342	57,312	50,342	60,852
26-27	88	75	48,021	51,156	48,525	50,136	50,342	57,264	56,569	61,212
28-29	62	51	47,387	53,700	50,146	50,928	50,342	57,984	53,925	66,492
30-31	38	46	46,114	54,324	44,450	53,412	50,342	62,412	50,342	65,892
32-33	30	35	45,543	55,824	43,424	55,512	50,342	61,368	50,342	64,968
34-35	44	63	46,301	55,644	43,424	55,512	50,342	60,912	57,481	69,852
36-40	55	73	45,542	56,280	43,424	55,512	50,342	61,512	50,342	68,832
41-50	10	16	44,862	57,960	43,424	57,012	45,154	66,012	58,577	74,292
>50	3	0	44,432		43,424		50,342		50,342	
UNKNOWN	28	0	34,730		33,424		40,167		50,647	
ALL	2,436	1,852	36,640	43,044	34,739	42,048	42,455	50,064	47,761	57,156

[a] YEARS SINCE RECEIPT OF BACCALAUREATE.
[b] NUMBER OF INCUMBENTS.
[c] FROM DMDC; JOB CODE 830.
[d] FROM DoE (REF. 22).

CHART VIII-54. CY-1987 SALARIES OF NONSUPERVISORY MECHANICAL ENGINEERS AT THE MASTER'S DEGREE LEVEL

MATURITY[a]	N[b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
	DoD[c]	DoE[d]	DoD	DoE	DoD	DoE	DoD	DoE	DoD	DoE
0		12		35,016		33,612		37,212		43,572
1		10		34,020		33,816		36,312		39,012
2	3	29	32,201	35,244	31,383	35,568	33,836	37,368	33,836	39,072
3	14	29	31,154	36,048	31,383	36,408	32,288	37,764	35,777	45,072
4	18	34	32,513	36,372	32,288	36,132	34,099	38,916	34,831	40,932
5	21	37	33,370	39,552	33,194	40,416	34,739	42,792	34,739	45,192
6	25	38	35,169	38,304	34,739	38,208	35,824	40,812	39,243	43,488
7	25	44	35,679	41,268	35,005	41,016	36,910	44,412	40,549	47,172
8	23	51	35,821	41,028	35,824	39,768	37,996	44,868	40,107	48,492
9	17	47	36,677	43,320	35,824	43,452	38,854	46,368	40,818	50,736
10	19	29	36,988	44,772	36,910	44,268	39,081	48,240	43,424	49,548
11	16	33	37,446	46,428	36,910	46,068	39,543	48,840	42,986	52,032
12	12	29	37,872	45,684	37,996	44,808	39,081	50,868	40,640	51,996
13	20	30	39,958	46,932	41,281	45,612	43,385	53,712	45,163	56,616
14	16	32	40,269	49,380	39,624	48,612	43,242	54,612	47,543	58,092
15	16	27	39,070	49,872	40,710	49,512	41,308	54,768	42,812	57,372
16	26	22	42,289	48,588	42,220	48,012	45,073	52,812	46,739	56,892
17	14	16	41,485	52,032	41,823	52,212	43,567	55,416	50,064	59,892
18	30	21	43,905	50,604	43,782	50,712	46,495	55,668	50,010	58,092
19	21	30	44,582	53,052	43,889	52,212	46,775	56,412	51,879	62,412
20	16	30	44,288	54,492	43,656	53,808	45,094	58,512	52,465	61,812
21	24	22	45,561	51,288	44,363	51,012	50,342	52,212	52,988	58,092
22-23	50	36	45,326	52,404	44,061	52,608	48,467	57,408	50,342	62,652
24-25	45	33	46,212	56,100	45,180	56,268	50,342	60,516	53,746	64,032
26-27	32	24	48,047	60,684	48,221	60,612	52,628	66,612	56,815	69,972
28-29	24	28	49,316	58,116	49,141	57,012	58,725	64,812	62,028	71,652
30-31	22	23	48,929	58,308	49,052	57,912	50,342	63,168	60,505	65,232
32-33	24	21	48,582	58,596	46,041	57,612	53,772	62,712	62,678	72,492
34-35	16	29	45,416	59,040	45,826	59,616	50,342	64,068	53,456	73,872
36-40	34	37	46,920	57,960	46,487	59,616	50,342	65,268	53,847	69,372
41-50	20	6	49,459	54,636	47,026	50,412	57,205	68,412	65,092	
>50	1	0	41,899		41,899		41,899		41,899	
ALL	644	889	42,330	47,604	42,338	46,464	46,471	54,480	50,342	61,584

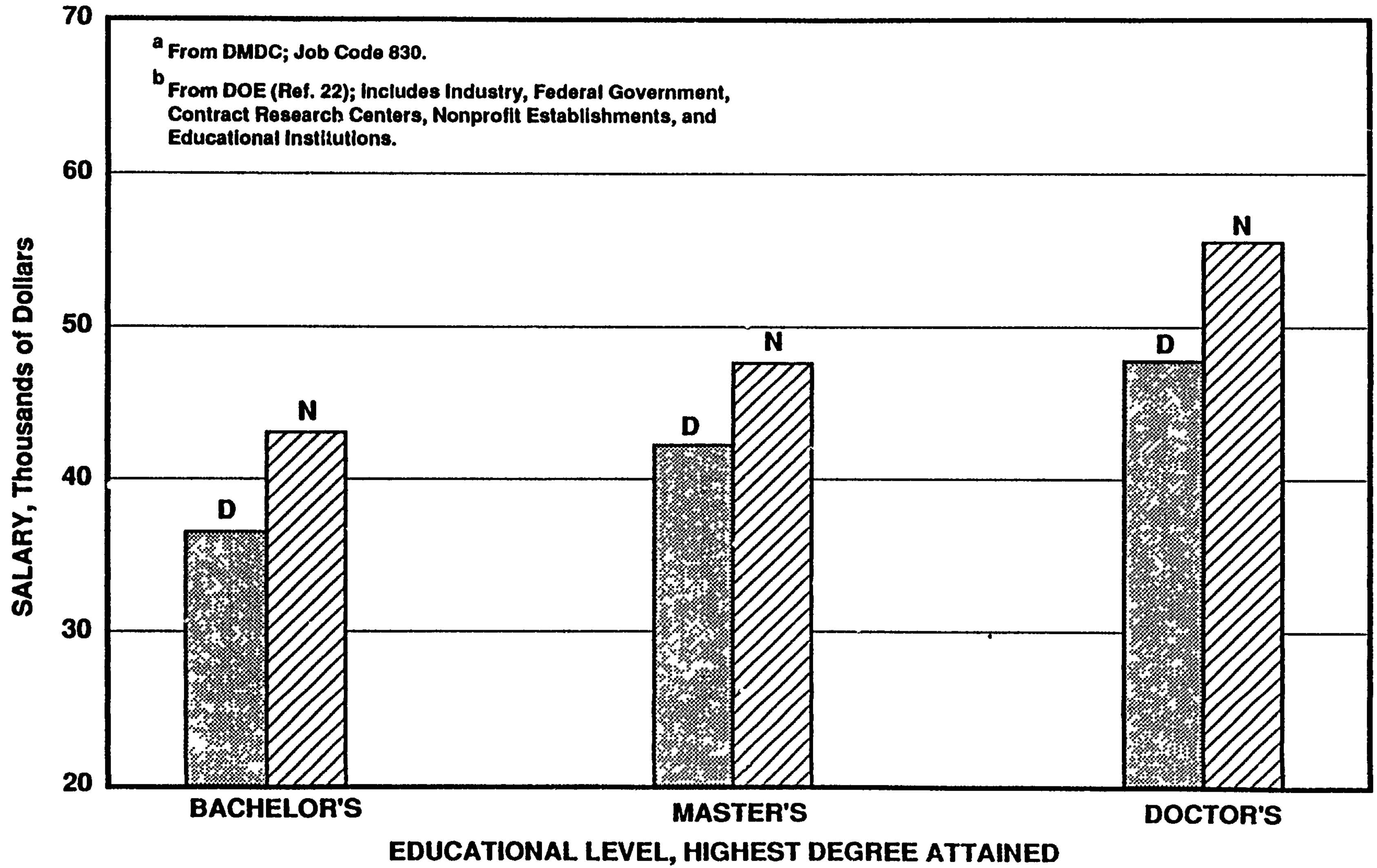
a YEARS SINCE RECEIPT OF BACCALAUREATE.
b NUMBER OF INCUMBENTS.
c FROM DMDC; JOB CODE 830.
d FROM DoE (REF. 22).

CHART VIII-55. CY-1987 SALARIES OF NONSUPERVISORY MECHANICAL ENGINEERS AT THE DOCTOR'S DEGREE LEVEL

MATURITY [a]	N [b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
	DoD [c]	DoE [d]	DoD	DoE	DoD	DoE	DoD	DoE	DoD	DoE
0										
1										
2										
3		1								
4		3		44,640						
5		3		46,200						
6		9		42,768		44,112		45,912		
7	2	12	39,082	46,812	39,082	48,612	41,253	50,412	41,253	51,972
8	1	8	40,018	48,816	40,018	49,212	40,018	51,612	40,018	
9	3	18	37,119	49,152	35,824	51,612	42,338	54,012	42,338	58,452
10	5	16	40,484	50,472	40,167	51,612	41,576	53,112	41,899	62,292
11	1	9	41,253	49,152	41,253	49,212	41,253	53,268	41,253	
12	1	21	39,081	50,244	39,081	51,312	39,081	55,440	39,081	58,092
13	4	9	40,904	53,136	41,730	53,112	43,018	56,268	43,245	
14	3	16	42,874	50,652	43,424	51,012	45,180	54,012	45,180	59,892
15	5	24	42,822	51,672	43,889	51,612	44,176	57,612	44,463	59,256
16	1	11	43,889	57,084	43,889	55,212	43,889	62,112	43,889	66,492
17	1	16	37,996	55,560	37,996	58,212	37,996	61,212	37,996	64,692
18	7	17	47,580	59,184	51,088	59,616	54,129	63,912	59,213	68,592
19	4	11	43,841	57,144	43,543	56,412	46,293	62,712	46,969	66,492
20	8	9	47,214	61,272	47,267	61,212	53,717	67,512	56,674	
21	9	21	49,676	56,484	49,076	56,712	56,803	61,068	60,371	65,292
22-23	19	35	49,562	59,364	50,339	59,112	54,311	64,368	57,418	69,312
24-25	8	34	44,873	57,168	43,114	58,212	52,067	63,852	53,390	68,532
26-27	12	27	49,562	63,084	49,697	62,412	54,915	67,368	59,034	72,192
28-29	10	15	51,905	62,844	51,104	62,412	60,444	69,168	62,975	73,212
30-31	7	11	48,499	60,300	49,052	59,112	57,966	66,912	64,595	70,092
32-33	10	13	53,700	63,000	50,342	58,512	64,195	68,712	69,740	80,652
34-35	3	2	54,031		50,342		66,570		66,570	
36-40	8	7	48,293	63,984	50,342	64,812	57,585	70,368	59,492	
41-50	6	3	52,295	56,340	49,170		66,631		69,383	
>50	1	0	43,424		43,424		43,424		43,424	
UNKNOWN										
ALL	139	381	47,700	55,524	46,471	54,900	53,390	61,440	59,492	67,608

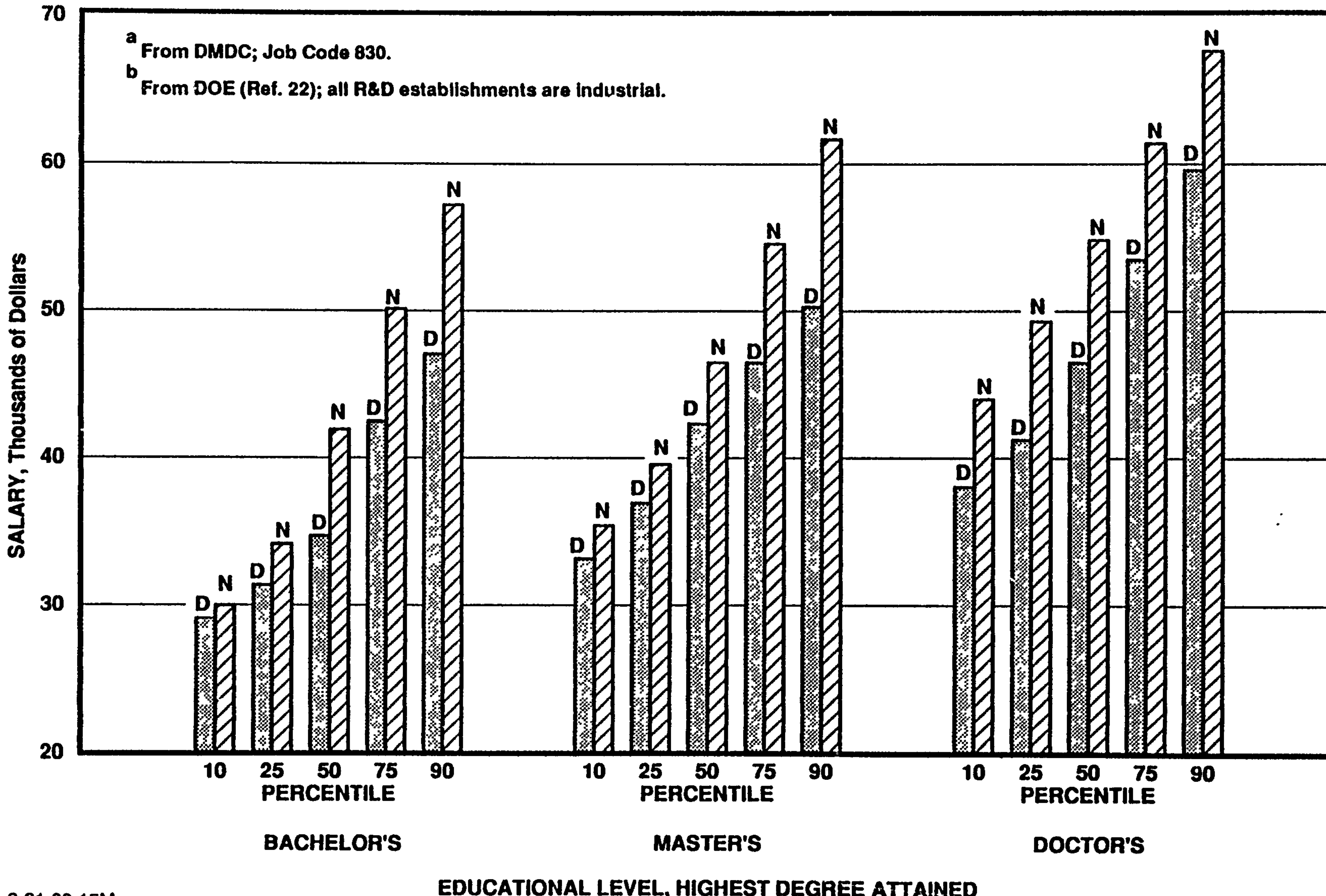
[a] YEARS SINCE RECEIPT OF BACCALAUREATE.
[b] NUMBER OF INCUMBENTS.
[c] FROM DMDC; JOB CODE 830.
[d] FROM DoE (REF. 22).

CHART VIII-56. COMPARISON OF AVERAGE SALARIES IN CY 1987 OF NON-SUPERVISORY MECHANICAL ENGINEERS IN DoD LABS (D) [a] AND NATIONAL R&D ESTABLISHMENTS (N)[b] FOR THREE EDUCATIONAL LEVELS



3-21-89-10M

CHART VIII-57. COMPARISON OF PERCENTILE SALARIES IN CY 1987 OF NON-SUPERVISORY MECHANICAL ENGINEERS IN DoD LABS (D)[a] AND NATIONAL R&D ESTABLISHMENTS (N)[b] FOR THREE EDUCATIONAL LEVELS



3-21-89-15M

CHART VIII-58. SALARIES OF FIRST LEVEL SUPERVISORS IN CY 1987

SECTOR	NUMBER OF SUPER-VISORS	AVERAGE SALARY, DOLLARS	PERCENTILE (P) SALARY, DOLLARS				
			10P	25P	50P	75P	90P
DoD LABS[a]	1,117	52,446	45,610	49,254	53,103	56,162	59,492
INDUSTRY[b]	2,317	58,392	45,192	50,832	58,548	64,992	70,080
NATIONAL[c]	4,403	59,004	45,888	51,504	59,364	66,000	71,004

[a] FROM DMDC; INCLUDES S&E (1) WHO HAVE ONE OF THE 89 JOB CODES LISTED IN CHART I-1 AND (2) WHO ARE GS-12, -13, OR -14 AND CODED "SUPERVISOR" OR WHO ARE CLASSIFIED AS GM-13 OR -14.

[b] FROM DoE (REF. 22); INCLUDES S&E SUPERVISORS IN INDUSTRIAL R&D ESTABLISHMENTS.

[c] FROM DoE (REF. 22); INCLUDES S&E SUPERVISORS IN R&D ESTABLISHMENTS IN SEVERAL SECTORS: INDUSTRY, FEDERAL GOVERNMENT, CONTRACT RESEARCH CENTERS, NONPROFIT ORGANIZATIONS, AND EDUCATIONAL INSTITUTIONS.

JM:kg-15
3/20/89

CHART VIII-59. SALARIES OF DIVISION DIRECTORS IN CY 1987

SECTOR	NUMBER OF SUPER-VISORS	AVERAGE SALARY, DOLLARS	PERCENTILE (P) SALARY, DOLLARS				
			10P	25P	50P	75P	90P
DoD LABS [a]	982	60,140	46,565	54,344	62,655	67,368	69,978
INDUSTRY [b]	1,180	73,944	59,004	66,492	72,996	79,944	88,752
NATIONAL [c]	1,537	74,700	59,472	66,600	73,500	81,420	91,992

[a] FROM DMDC; INCLUDES S&E (1) WHO HAVE ONE OF THE 89 JOB CODES LISTED IN CHART I-1 AND (2) WHO ARE GS-15, -16, -17, -18 OR SES.

[b] FROM DoE (REF. 22); INCLUDES S&E SUPERVISORS IN INDUSTRIAL R&D ESTABLISHMENTS.

[c] FROM DoE (REF. 22); INCLUDES S&E SUPERVISORS IN R&D ESTABLISHMENTS IN SEVERAL SECTORS: INDUSTRY, FEDERAL GOVERNMENT, CONTRACT RESEARCH CENTERS, NON-PROFIT ORGANIZATIONS, AND EDUCATIONAL INSTITUTIONS.

JM:kg-16
3/20/89

CHART VIII-60. CY-1987 SALARIES OF NONSUPERVISORY ENGINEERS AT THE BACHELOR'S DEGREE LEVEL

	N[b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
MATURITY[a]	DoD[c]	EMC[d]	DoD	EMC	DoD	EMC	DoD	EMC	DoD	EMC
0	239	2,102	23,986	29,200	23,865	29,450	23,865	30,900	28,325	32,000
1	886	3,262	27,482	30,550	29,197	30,750	29,197	32,550	29,946	34,050
2	847	3,764	29,937	31,900	29,946	32,050	31,383	34,200	32,288	36,000
3	956	3,310	32,344	33,250	32,123	33,350	33,674	35,800	35,756	37,950
4	625	3,087	33,911	34,550	34,099	34,600	35,756	37,350	36,885	39,900
5	434	3,327	35,400	35,800	35,353	35,800	36,910	38,850	38,727	41,750
6	370	3,030	36,671	37,000	36,885	36,950	38,727	40,300	40,152	43,500
7	243	2,405	37,173	38,150	36,910	38,100	39,143	41,650	41,308	45,200
8	216	2,123	38,507	39,250	38,727	39,150	40,326	42,950	42,599	46,800
9–11	506	4,620	40,014	41,200	40,272	41,050	42,582	45,250	43,889	49,700
12–14	611	3,898	41,898	43,600	42,530	43,400	43,889	48,050	46,546	53,200
15-17	565	3,563	43,326	45,350	42,599	45,150	45,180	50,100	48,848	55,800
18-20	475	2,588	45,184	46,550	44,787	46,350	47,675	51,500	50,342	57,550
21-23	559	2,354	47,159	47,350	46,471	47,100	50,342	52,400	54,170	58,650
24-26	625	2,397	48,216	47,750	47,761	45,550	50,342	52,900	56,148	59,250
27-29	567	2,218	49,057	48,000	50,229	47,800	50,342	53,150	57,792	59,600
30-32	262	2,829	49,197	48,100	50,202	47,900	50,342	53,300	59,492	59,750
33+	556	3,915	47,967	48,150	47,633	47,950	50,342	53,350	59,492	59,850
UNKNOWN	63		35,020		33,194		41,308		50,342	
ALL	9,607	54,799	38,699	40,250	38,011	38,700	44,787	46,200	50,342	52,750

a YEARS SINCE RECEIPT OF BACCALAUREATE.
b NUMBER OF INCUMBENTS.
c FROM DMDC; 22 ENGINEERING JOB CODES FROM CHART I-1.
d FROM EMC (REF. 23).

CHART VIII-61. CY-1987 SALARIES OF NONSUPERVISORY ENGINEERS AT THE MASTER'S DEGREE LEVEL

MATURITY [a]	N [b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
	DoD [c]	EMC [d]	DoD	EMC	DoD	EMC	DoD	EMC	DoD	EMC
0	0	38								
1	1	235	29,197		29,197		29,197		29,197	
2	16	595	29,870	36,300	29,197	36,600	31,383	38,500	32,677	40,800
3	47	614	31,348	37,200	31,383	37,450	32,288	39,850	34,739	42,250
4	51	805	32,360	38,150	32,288	38,350	34,099	41,250	35,737	43,750
5	81	891	33,827	39,200	33,653	39,300	34,739	42,650	36,885	45,250
6	77	849	35,065	40,250	34,739	40,300	36,107	44,000	38,384	46,800
7	81	789	36,374	41,300	35,824	41,300	39,112	45,300	41,271	48,350
8	90	811	37,006	42,400	36,910	42,300	39,993	46,600	41,308	49,900
9–11	230	2,149	37,705	44,450	37,996	44,300	40,530	49,000	42,599	52,850
12–14	244	1,782	40,571	47,250	41,308	47,000	42,599	52,050	45,794	56,800
15-17	351	1,540	42,678	49,500	42,599	49,150	45,180	54,350	48,597	59,900
18-20	415	1,206	44,942	51,100	44,028	50,700	47,288	56,000	51,129	62,200
21-23	438	1,180	47,020	52,200	45,916	51,700	50,341	57,050	55,155	63,700
24-26	336	1,053	49,196	52,800	49,523	52,350	53,390	57,700	57,916	64,600
27-29	295	879	50,965	53,150	50,342	52,650	55,966	58,000	61,567	65,050
30-32	224	758	51,133	53,300	50,342	52,800	56,633	58,150	60,395	65,250
33+	409	1,378	49,795	53,350	49,052	52,850	54,515	58,250	59,492	65,400
ALL	3,386	17,552	44,752	46,550	43,889	46,700	50,339	52,150	55,513	58,800

a YEARS SINCE RECEIPT OF BACCALAUREATE.
b NUMBER OF INCUMBENTS.
c FROM DMDC; 22 ENGINEERING JOB CODES FROM CHART I-1.
d FROM EMC (REF. 23).

CHART VIII-62. CY-1987 SALARIES OF NONSUPERVISORY ENGINEERS AT THE DOCTOR'S DEGREE LEVEL

	N[b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
MATURITY[a]	DoD[c]	EMC[d]	DoD	EMC	DoD	EMC	DoD	EMC	DoD	EMC
0	0	5								
1	0	1								
2	0	13								
3	0	6								
4	1	28	32,568		32,568		32,568		32,568	
5	0	52		47,650		48,100		51,550		53,500
6	4	145	39,162	47,300	38,539	47,750	44,479	50,700	45,916	53,200
7	5	143	41,842	47,350	42,530	47,750	44,258	50,500	45,916	53,400
8	9	184	40,375	47,750	41,308	48,100	43,659	50,750	45,916	54,050
9–11	30	624	39,496	49,150	40,015	49,350	41,308	52,200	42,573	56,100
12–14	39	702	41,265	51,950	42,338	51,850	43,889	55,450	45,916	60,150
15-17	41	591	45,851	54,800	44,463	54,400	49,943	58,900	53,547	64,350
18-20	84	646	48,006	57,150	47,552	56,450	52,386	61,900	55,966	67,850
21-23	110	623	49,617	58,800	50,215	57,950	54,602	64,050	57,873	70,400
24-26	125	433	50,709	59,850	50,339	58,850	54,868	65,400	61,520	72,050
27-29	90	348	52,299	60,400	51,783	59,350	58,663	66,150	64,547	72,900
30-32	49	252	52,928	60,650	51,919	59,600	59,492	66,500	65,714	73,300
33+	86	377	52,157	60,800	50,342	59,700	59,218	66,650	66,965	73,500
ALL	673	5,173	49,110	55,200	49,052	53,850	54,162	60,300	59,492	67,650

a YEARS SINCE RECEIPT OF BACCALAUREATE.
b NUMBER OF INCUMBENTS.
c FROM DMDC; 22 ENGINEERING JOB CODES FROM CHART I-1.
d FROM EMC (REF. 23).

CHART VIII-63. COMPARISON OF AVERAGE SALARIES IN CY 1987 OF NON-SUPERVISORY ENGINEERS IN DoD LABS (D)[a] AND ALL INDUSTRIES (N)[b] FOR THREE EDUCATIONAL LEVELS

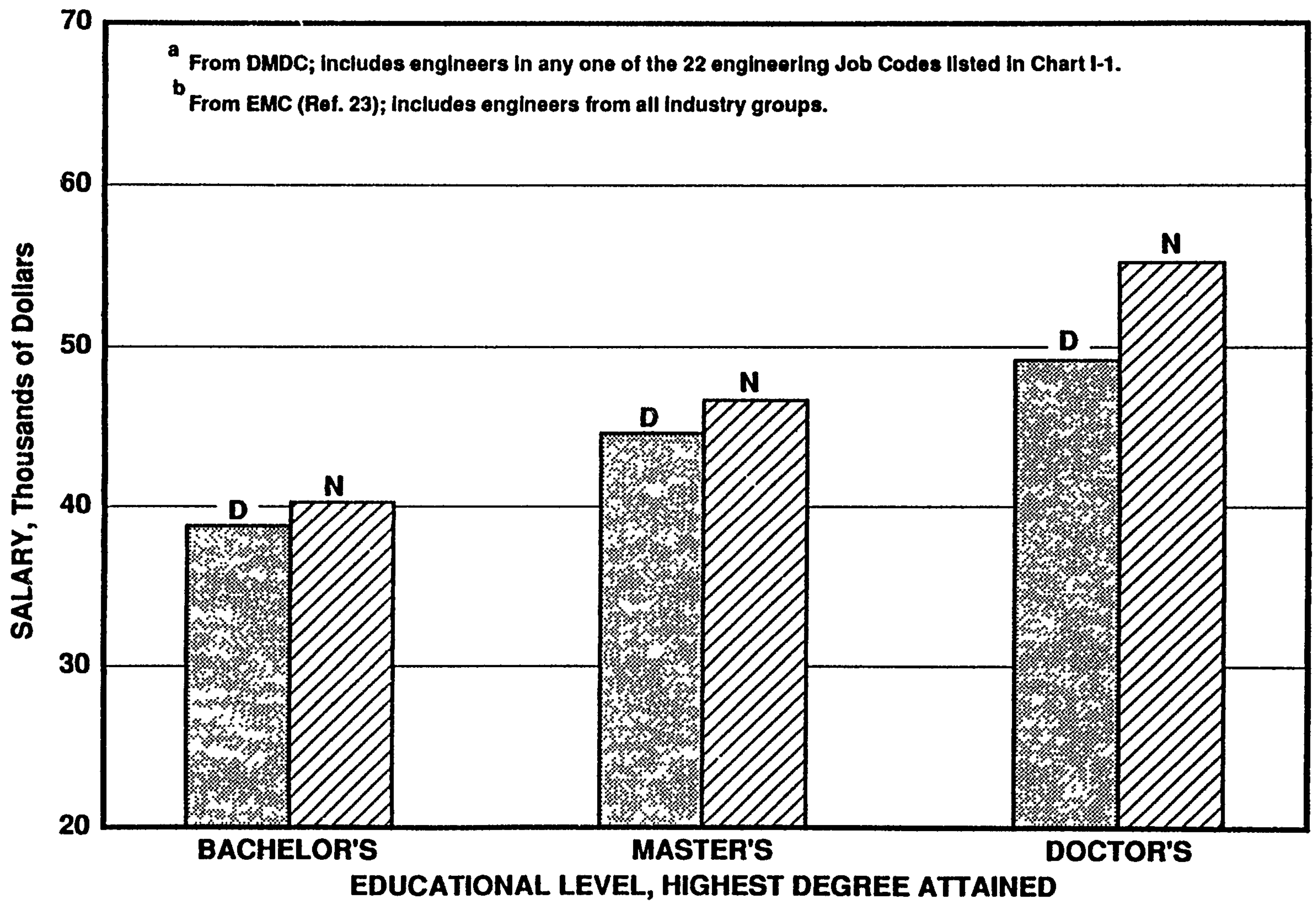


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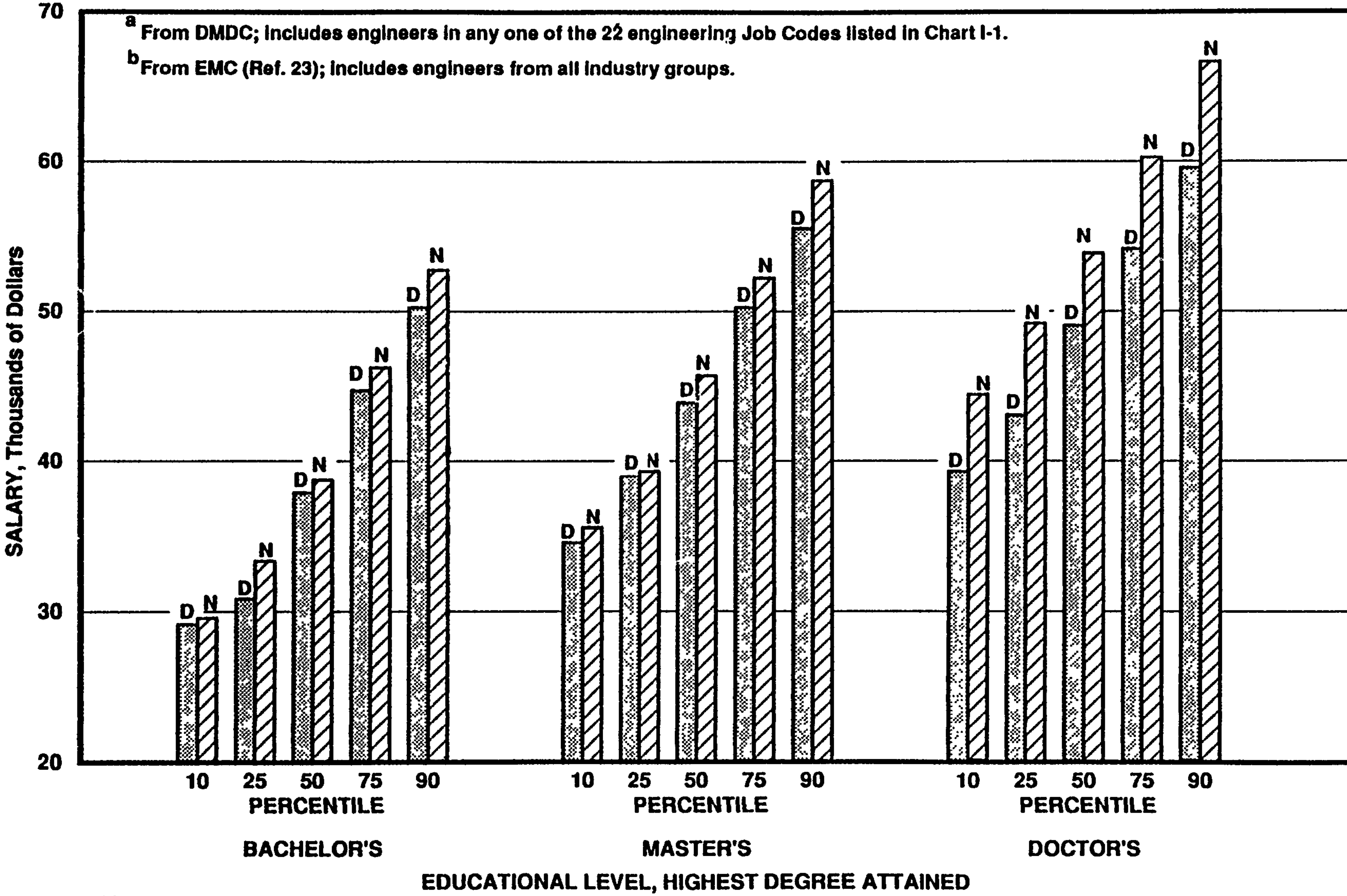
CHART VIII-64. COMPARISON OF PERCENTILE SALARIES IN CY 1987 OF NON-SUPERVISORY ENGINEERS IN DoD LABS (D)[a] AND ALL INDUSTRIES NATIONALLY (N)[b] FOR THREE EDUCATIONAL LEVELS



[a] From DMDC; includes engineers in any one of the 22 engineering Job Codes listed in Chart I-1.

[b] From EMC (Ref. 23); includes engineers from all industry groups.

3-21-89-17M

CHART VIII-65. CY-1987 SALARIES OF SUPERVISORY ENGINEERS AT THE BACHELOR'S DEGREE LEVEL

MATURITY [a]	N [b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
	DoD [c]	EMC [d]	DoD	EMC	DoD	EMC	DoD	EMC	DoD	EMC
0	0	7								
1	2	67	40,093		40,093		56,320		56,320	
2	1	99	31,574		31,574		31,574		31,574	
3	3	132	34,284		34,739		35,824		35,824	
4	3	172	45,345	38,850	43,460	38,650	59,177	44,150	59,177	47,450
5	2	354	34,136	40,050	34,136	39,700	35,756	44,950	35,756	48,850
6	5	366	46,417	41,350	46,524	40,850	58,633	46,000	69,978	50,450
7	8	545	47,732	42,750	40,181	42,100	63,165	47,250	69,978	52,200
8	6	551	45,005	44,200	44,861	43,450	48,941	48,650	53,899	54,150
9–11	38	1,298	45,725	47,200	45,095	46,200	47,727	51,750	54,049	58,200
12–14	81	1,765	47,568	51,600	47,288	50,200	50,609	56,500	54,198	64,400
15-17	98	1,993	50,484	55,400	50,221	53,650	54,258	60,850	58,965	70,000
18-20	117	1,765	53,307	58,350	52,763	56,300	56,848	64,350	60,285	74,450
21-23	135	1,612	54,497	60,400	54,127	58,100	57,900	66,750	64,568	77,550
24-26	180	1,686	55,979	61,600	55,173	59,200	61,979	68,250	66,201	79,500
27-29	197	1,763	59,038	62,250	58,432	59,800	65,055	69,050	69,242	80,550
30-32	97	1,554	59,811	62,250	59,492	60,100	66,604	69,450	69,978	81,050
33+	126	2,272	59,418	62,700	59,492	60,200	66,328	69,600	69,978	81,250
UNKNOWN	5		49,495		54,409		56,676		58,730	
ALL	1,104	18,011	54,961	56,150	54,416	54,050	59,492	63,350	67,020	74,150

[a] YEARS SINCE RECEIPT OF BACCALAUREATE.
[b] NUMBER OF INCUMBENTS.
[c] FROM DMDC; 22 ENGINEERING JOB CODES FROM CHART I-1.
[d] FROM EMC (REF. 23).

CHART VIII-66. CY-1987 SALARIES OF SUPERVISORY ENGINEERS AT THE MASTER'S DEGREE LEVEL

	N[b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
MATURITY[a]	DoD[c]	EMC[d]	DoD	EMC	DoD	EMC	DoD	EMC	DoD	EMC
0	0	0								
1	0	1								
2	0	14								
3	0	36								
4	0	27		51,200		51,850		55,600		61,200
5	1	45	40,018	50,550	40,018	50,950	40,018	55,100	40,018	60,150
6	0	87		50,500		50,700		55,200		60,000
7	0	148		50,850		50,900		55,750		60,500
8	4	161	42,873	51,600	42,303	51,450	45,147	56,600	45,763	61,450
9–11	8	582	45,123	53,650	44,826	53,200	48,814	58,960	50,340	64,350
12–14	32	788	45,286	57,450	45,472	56,600	48,877	63,150	51,976	70,000
15-17	65	1,032	50,282	61,300	50,121	60,000	53,759	67,250	57,609	75,800
18-20	104	1,039	52,043	64,450	51,414	62,850	55,421	70,600	59,827	80,800
21-23	113	944	55,447	66,700	55,210	64,850	60,451	73,050	63,858	85,450
24-26	131	836	58,207	68,150	57,418	66,100	62,759	74,500	67,005	86,750
27-29	132	791	59,240	68,900	59,492	66,800	64,859	75,350	69,978	88,050
30-32	89	564	60,411	69,250	59,492	67,100	67,127	75,700	69,978	88,650
33+	107	950	61,547	69,450	60,781	67,300	68,989	75,900	69,978	88,950
ALL	786	8,048	56,456	63,750	56,109	61,650	62,655	70,600	68,225	81,350

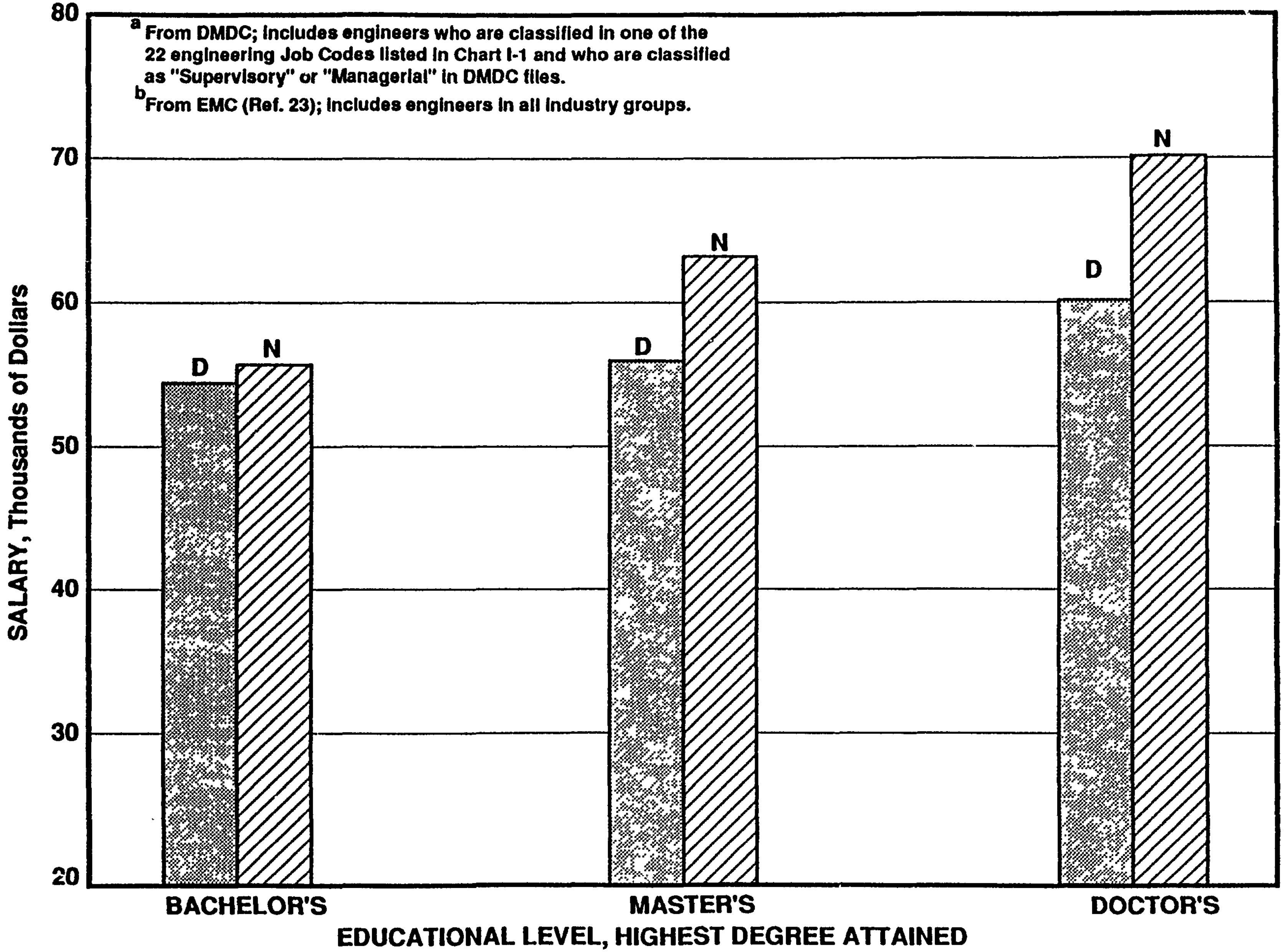
a YEARS SINCE RECEIPT OF BACCALAUREATE.
b NUMBER OF INCUMBENTS.
c FROM DMDC; 22 ENGINEERING JOB CODES FROM CHART I-1.
d FROM EMC (REF. 23).

CHART VIII-67. CY-1987 SALARIES OF SUPERVISORY ENGINEERS AT THE DOCTOR'S DEGREE LEVEL

	N[b]		AVERAGE SALARY		PERCENTILE (P) SALARY					
					50P		75P		90P	
MATURITY[a]	DoD[c]	EMC[d]	DoD	EMC	DoD	EMC	DoD	EMC	DoD	EMC
0	0	0								
1	0	0								
2	0	1								
3	0	0								
4	0	4								
5	0	7								
6	0	4								
7	1	3	42,599		42,599		42,599		42,599	
8	0	7								
9–11	2	64	47,092	60,650	47,092	60,250	54,166	66,200	54,166	68,350
12–14	1	191	43,219	61,350	43,219	60,550	43,219	66,700	43,219	73,100
15-17	14	290	52,143	65,000	51,810	64,000	56,811	70,750	65,728	78,800
18-20	33	368	56,602	69,100	53,971	68,050	60,847	75,500	69,274	83,950
21-23	39	349	58,901	72,550	59,198	71,400	63,135	79,450	69,978	87,900
24-26	34	303	61,538	74,850	62,286	73,750	65,393	82,200	69,097	90,450
27-29	33	187	61,774	76,200	62,882	75,050	67,085	83,750	69,859	91,900
30-32	19	179	63,247	76,850	65,584	75,700	68,500	84,500	69,978	92,550
33+	33	182	66,067	77,150	69,978	76,000	70,761	84,850	70,761	92,900
ALL	209	2,144	60,228	70,550	60,427	69,250	67,161	77,950	69,978	87,850

a YEARS SINCE RECEIPT OF BACCALAUREATE.
b NUMBER OF INCUMBENTS.
c FROM DMDC; 22 ENGINEERING JOB CODES FROM CHART I-1.
d FROM EMC (REF. 23).

CHART VIII-68. COMPARISON OF AVERAGE SALARIES IN CY 1987 OF SUPERVISORY ENGINEERS IN DoD LABS (D)[a] AND ALL INDUSTRIES NATIONALLY (N)[b] FOR THREE EDUCATIONAL LEVELS



[a] From DMDC; includes engineers who are classified in one of the 22 engineering Job Codes listed in Chart I-1 and who are classified as "Supervisory" or "Managerial" in DMDC files.

[b] From EMC (Ref. 23); includes engineers in all industry groups.

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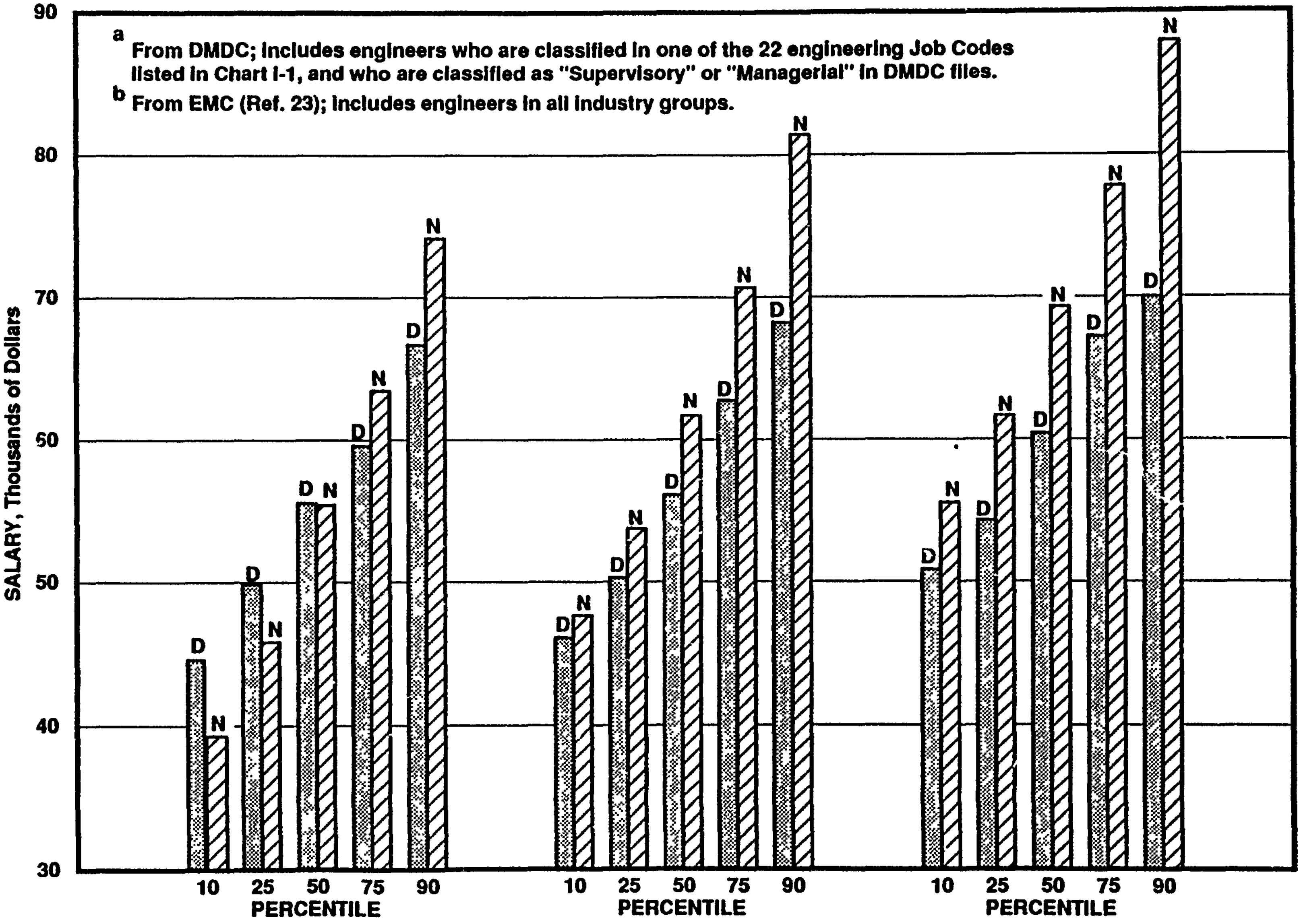
CHART VIII-69. COMPARISON OF PERCENTILE SALARIES IN CY 1987 OF SUPERVISORY ENGINEERS IN DoD LABS (D)[a] AND ALL INDUSTRIES NATIONALLY (N)[b] FOR THREE EDUCATIONAL LEVELS



[a] From DMDC; includes engineers who are classified in one of the 22 engineering Job Codes listed in Chart I-1, and who are classified as "Supervisory" or "Managerial" in DMDC files.

[b] From EMC (Ref. 23); includes engineers in all industry groups.

3-21-89-19M

IX. BENEFITS

IX. BENEFITS

We expect that most individuals consider prospective pensions and other fringe benefits when making employment decisions. And we expect policymakers to consider employee benefits when setting pay scales. Thus, we are interested in comparing total compensation in the Federal sector and the private sector. While the preceding chapter indicates there is substantial data pertaining to pay comparability, our search found much less data pertaining to comparability of benefits or total compensation, i.e., pay plus benefits. Available data enables us to make the benefits comparisons in Charts IX-1, -2, and -3.

Chart IX-1, which summarizes a U.S. Office of Personnel Management (OPM) analysis done in 1981 (Ref. 24), shows that, in terms of percent of pay, the average Federal pension is almost 12 percent better than the average private-sector pension. Advantages in other benefits to private-sector workers reduce the net advantage in overall benefits to about seven percent for the Federal sector.

In a 1984 study of total compensation for the House of Representatives Committee on Post Office and Civil Service (Ref. 25), Chart IX-2 shows that the Federal retirement plan is over six percent more valuable, in terms of percent of pay, than the average retirement plan in the private sector. Here again, the superior value of other benefits in the private sector reduce the net overall advantage to 2.5 percent for the Federal sector.

A recent (1987) National Institute of Standards and Technology (NIST, which was formerly the National Bureau of Standards) report on total compensation comparability (Ref. 26) indicates that the value of benefits, as a percentage of base salary, favors S&E at NIST over S&E in the private sector by about the same margin shown in Chart IX-2. The percentage differences in benefits values are 3.3-, 3.6-, 3.5-, 3.3-, 3.0-, 2.7-, and 2.5-percent for S&E base salaries of $20K, $30K,

$40K, $50K, $60K, $70K, and $80K, respectively. The source for private-sector benefits for this NIST project is also the source of the study summarized in Chart IX-2.

Chart IX-3 compares 1988 retirement-benefits data from the U.S. Bureau of Labor Statistics (Ref. 27) for the private sector with annual annuities for Federal personnel who retire under the Civil Service Retirement System (Ref. 28). Both sets of data pertain to defined-benefits pensions. The $45K and $55K anual earnings are the two highest levels of final earnings used by the BLS in determining average replacement rate, which is the portion of earnings that is replaced by pension.

The BLS survey averages apply to professional and administrative groups in manufacturing and nonmanufacturing industries in the contiguous U.S. The 1.43 million workers in these groups comprise 30 percent of 4.79 million workers in the BLS survey and 24 percent of all such workers in medium and large establishments.

Chart IX-3 shows that for a final- or highest-three-year salary of $45K the average replacement rate of a retiree's earnings favor the private-sector employee by a few percent when length of service is 20 or 30 years, but favors the Federal employee by 16 percent when retirement is taken after 40 years. When the final- or highest-three-year salary is $55K, the average replacement rates grow more favorable to the Federal retiree.

A comparative advantage of Federal pensions that is not apparent from the values or replacement rates in Charts IX-1, -2, and -3 is the Federal retirement increases that are tied to the consumer price index. The OPM study indicates that, except for Social Security increases, 97 percent of private-sector pensions have no such automatic adjustments for inflation (Ref. 24). Similarly, the more recent BLS report indicates that, again except for increases in Social Security, only four percent of private sector participants are in pension plans that provide automatic increases in pension benefits to compensate for increases in the cost of living. Another advantage of Federal pensions is early normal retirement: few defined benefit pension plans in the private sector offer full annuities at age 55 after 30 years of service, at age 60 with at least 20 years of service, or at age 62 with at least five years of service as the CSRS plan does (Refs. 27 and 28).

We have not attempted to compare private-sector pensions from the BLS Survey with Federal-sector retirement benefits under the new Federal Employees' Retirement System, a three-tiered--Social Security, a basic annuity plan (BAP), and a thrift-savings plan (TSP)--retirement plan that became effective at the beginning of 1987. While retirement benefits from Social Security and the BAP can be estimated reliably, uncertain future performance of the funds in which employee and employer contributions are invested make defined benefits from the TSP much more difficult to estimate.

CHART IX-1. BENEFITS COMPARISON I[a]

BENEFIT	VALUE AS PERCENT OF PAY	
	PRIVATE SECTOR	FEDERAL SECTOR
RETIREMENT PLUS LONG-TERM DISABILITY	16.7 %	28.2 %
LIFE INSURANCE	0.5	0.3
LEAVE ADJUSTMENT	-1.1	
SECONDARY BENEFITS:		
PROFIT SHARING	2.4	
SAVINGS AND THRIFT PLANS	0.4	
PARKING	0.5	
AUTOMOBILE FOR PERSONAL USE	0.3	
TRAUMATIC INJURY		0.1
EDUCATIONAL ASSISTANCE	0.1	0.2
MISCELLANEOUS PAID NONWORK TIME	0.4	0.3
MISCELLANEOUS CAPITAL ACCUMULATION	0.7	
SEVERANCE PAY		0.1
EMPLOYEE DISCOUNTS	0.1	
PERIPHERAL BENEFITS	0.6	0.5
BONUSES	0.9	
TOTAL	22.5	29.7

[a] SOURCE: U.S. OFFICE OF PERSONNEL MANAGEMENT (REF. 24); RETIREMENT BENEFIT VALUES DO NOT REFLECT AN ADVANTAGE OF FEDERAL PENSIONS, WHICH INCREASE AS THE COST OF LIVING INCREASES, OVER PRIVATE-SECTOR PENSIONS, 97 PERCENT OF WHICH HAVE NO INFLATION ADJUSTMENTS.

JM:kg-1
10/24/89

CHART IX-2. BENEFITS COMPARISON II

BENEFIT	FEDERAL GOVERNMENT BENEFITS ARE OF GREATER OR LESSER VALUE--IN TERMS OF PERCENT OF PAY--THAN THE AVERAGE OFFERED BY THE PRIVATE SECTOR.	
	GREATER	LESSER
RETIREMENT PLAN	6.4%	
NONRETIREMENT PACKAGE		3.6%

SOURCE: BY HAY HUGGINS COMPANY AND HAY MANAGEMENT CONSULTANTS (REF. 25).

JM:kg-2
10/24/89

CHART IX-3. BENEFITS COMPARISON III

RETIREMENT SYSTEM	FINAL- OR HIGHEST-3-YEAR SALARY	AVERAGE REPLACEMENT RATES[a] FOR SPECIFIC EARNINGS AND YEARS OF SERVICE		
		20 YEARS	30 YEARS	40 YEARS
COMBINED PRIVATE PENSION AND PRIMARY SOCIAL SECURITY BENEFIT FOR PROFESSIONAL AND ADMINISTRATIVE PERSONNEL[b]	$45K	44.2%	53.8%	60.1%
	$55K	40.8%	50.3%	56.9%
COMPARATIVE ANNUAL ANNUITIES FOR CIVIL SERVICE RETIREMENT SYSTEM[c]	$45K	36.25%	56.25%	76.25%
	$55K	36.25%	56.25%	76.25%

[a] RETIREMENT RATE = PORTION OF A RETIREE'S EARNINGS THAT IS REPLACED BY RETIREMENT BENEFITS. REPLACEMENT RATES DO NOT REFLECT AN ADVANTAGE OF FEDERAL PENSIONS, WHICH INCREASE WITH THE COST OF LIVING, OVER PRIVATE-SECTOR PENSIONS, ONLY FOUR PERCENT OF WHICH HAVE SUCH COST-OF-LIVING ADJUSTMENTS (REF. 27)

[b] SOURCE: U.S. BUREAU OF LABOR STATISTICS (REF. 27). ASSUMES (1) RETIREMENT AT AGE 65 AND (2) RETIREE PAID INTO SOCIAL SECURITY FOR 40 YEARS.

[c] SOURCE: "FEDERAL EMPLOYEES' ALMANAC, 1989" (REF. 28).

JM:kg-3
10/24/89

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REFERENCES

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APPENDIX

LABORATORY QUESTIONNAIRE

Date ____________

Name of Laboratory Activity: ________________________________

Military Base/Location: ________________________________

Street Address: ________________________________

City: ________________________________

State: ________________________________

Zip Code: ________________________________

Parent Command: ________________________________

Point of Contact for this questionnaire: (Last Name, First Name, Middle Initial) ________________________________

Phone Number: Commercial (area code)( ) ________________________________

Autovon ________________________________

Please append copy of laboratory mission statement.

INVENTORY DATA

1. How many part-time or temporary scientist and engineer (S&E) workers were on board as of 30 September 1986?

End of FY 1986 Inventory (numbers)

Civilians	Co-op*	Aides*	Other* Temps	Part-time* Permanent
Scientists	____	____	____	____
Engineers	____	____	____	____
All others	____	____	____	____
Total	____	____	____	____

2. How many of the above temporary S&E employees are rehired annuitants?

   Scientists ______ Engineers ______

3. How many contract (full-time equivalent) S&E's worked on the base in FY86?

   Scientists ______ Engineers ______

4. Based on your experience during the past 5 years, please estimate the percentage of S&E part-time, co-op, aide and other workers who become full-time permanent employees and the percentage of these who remain with your activity 3 years or longer.

	% of Those Who Become Full-Time Permanent Employees	% Of Those Who Become Full-Time Permanent Employees Who Remain 3 Or More Years
Part-time permanent* (FPM, Ch. 340)	____	____
Co-op* (FPM, Ch. 308)	____	____
Aide* (FPM, Ch. 213, 213.3102(Q) and (AA))	____	____
Other Temporary* (FPM, Ch. 340)	____	____

*As defined in Federal Personnel Manual, "Employment Programs."

5. How many full-time permanent S&E's were on board as of 30 September 1986 (End FY1986)? ________

6. What percentage of your full-time allocated S&E manpower worked on the following types of work in FY 1986?

	<u>% S&E Manpower</u>
Tech Base (6.1, 6.2, 6.3a)*	______
Systems Development (6.3b, 6.4)*	______
Test and Evaluation	______
Product Support	______
Other (specify)__________	______
__________	______
__________	______
Total	100%

7. What was the laboratory's total budget for FY 1986? $ __________

8. What percentage, on a dollar basis, of your technical work was contracted out in FY86? __________%

9. What percentage, on a dollar basis, of the performance of this technical contract work is conducted on-base? __________%

*See R&D funding categories in <u>DoD Budget Guidance Manual, DoD7110-1-M</u>, p. 516-1.

10. What percentage of full-time S&E manpower at your activity spent time accomplishing the following kinds of jobs in FY 1986?

	% S&E Manpower
In-house technical (Bench or "hands-on") work	______
Line management	______
Contract monitoring	______
Staff administration	______
Planning	______
Director/Advisory	______
Support to operational forces	______
Assigned to activity outside the laboratory and not reporting to the lab	______
Other (specify) __________	______
______________________	______
Total	100%

11. PLEASE LIST BY JOB SERIES AND GRADE THE LABORATORY'S AUTHORIZATION FOR NUMBER OF S&E PERSONNEL (ESTABLISHED POSITIONS WITHIN PERSONNEL CEILINGS) AND VALIDATED REQUIREMENTS AS OF 30 SEPTEMBER 1986 (END FY 1986) AND REQUIREMENTS FOR 30 SEPTEMBER 1987 (END FY 1987).

ENGINEERS		TOTAL END FY 1986		TOTAL END FY 1987		AUTHORIZATION END OF FY 1986 CIVILIAN GRADES												AUTHORIZATION END OF 1986 MILITARY GRADES						
		AUTH.	REQ.	AUTH.	REQ.	GS5	GS6	GS7	GS8	GS9	GS10	GS11	GS12	GS13	GS14	GS15	PL/SES GS16-18	01	02	03	04	05	06	07
801	GENERAL ENGINEERING																							
803	SAFETY ENGINEERING																							
804	FIRE PREVENTION ENGINEERING																							
806	MATERIALS ENGINEERING																							
807	LANDSCAPE ARCHITECTURE																							
808	ARCHITECTURE																							
810	CIVIL ENGINEERING																							
819	ENVIRONMENTAL ENGINEERING																							
830	MECHANICAL ENGINEERING																							
840	NUCLEAR ENGINEERING																							
850	ELECTRICAL ENGINEERING																							
855	ELECTRONICS ENGINEERING																							
858	BIOMEDICAL ENGINEERING																							
861	AERONAUTICS ENGINEERING																							
871	NAVAL ARCHITECTURE																							
880	MINING ENGINEERING																							
881	PETROLEUM PRODUCTION & NATURAL GAS ENGINEERING																							

AUTHORIZATIONS - ESTABLISHED POSITIONS TO BE HIRED OR ASSIGNED AGAINST. RESULTS FROM ALLOCATION OF CEILINGS AND END STRENGTHS AUTHORIZED BY CONGRESS.
REQUIREMENTS - VALIDATED REQUIREMENTS FOR PERSONNEL ABOVE THE ALLOCATED AUTHORIZATION. SHOULD NOT BE "BLUE-SKY" WISH LIST. SHOULD BE RECOGNIZED BY SERVICE HEADQUARTERS AS VALID REQUEST TO MAN IF AUTHORIZED CEILING WERE RAISED.

11. PLEASE LIST BY JOB SERIES AND GRADE THE LABORATORY'S AUTHORIZATION FOR NUMBER OF S&E PERSONNEL (ESTABLISHED POSITIONS WITHIN PERSONNEL CEILINGS) AND VALIDATED REQUIREMENTS AS OF 30 SEPTEMBER 1986 (END FY 1986) AND REQUIREMENTS FOR 30 SEPTEMBER 1987 (END FY 1987).

ENGINEERS (CONT'D)	TOTAL END FY 1986		TOTAL END FY 1987		AUTHORIZATION END OF FY 1986 CIVILIAN GRADES												AUTHORIZATION END OF 1986 MILITARY GRADES						
	AUTH.	REQ.	AUTH.	REQ.	GS5	GS6	GS7	GS8	GS9	GS10	GS11	GS12	GS13	GS14	GS15	PL/SES GS16-18	01	02	03	04	05	06	07
890 AGRICULTURE ENGINEERING																							
892 CERAMIC ENGINEERING																							
893 CHEMICAL ENGINEERING																							
894 WELDING ENGINEERING																							
896 INDUSTRIAL ENGINEERING																							
OTHER (SPECIFY JOB SERIES & POSITION TITLE)																							
ENGINEER SUBTOTALS																							
SCIENTISTS																							
101 SOCIAL SCIENCE																							
150 GEOGRAPHY																							
184 PSYCHOLOGY																							
190 GENERAL ANTHROPOLOGY																							
193 ARCHEOLOGY																							
401 GENERAL BIOLOGY																							
403 MICROBIOLOGY																							

11. PLEASE LIST BY JOB SERIES AND GRADE THE LABORATORY'S AUTHORIZATION FOR NUMBER OF S&E PERSONNEL (EST[illegible]SHED POSITIONS WITHIN PERSONNEL CEILINGS) AND VALIDATED REQUIREMENTS AS OF 30 SEPTEMBER 1986 (END FY 1986) AND REQUIREMENTS FOR 30 SEPTEMBER 1987 (END FY 1987).

SCIENTISTS (CONT)		TOTAL END FY 1986		TOTAL END FY 1987		AUTHORIZATION END OF FY 1986 CIVILIAN GRADES												AUTHORIZATION END OF 1986 MILITARY GRADES						
		AUTH.	REQ.	AUTH.	REQ.	GS5	GS6	GS7	GS8	GS9	GS10	GS11	GS12	GS13	GS14	GS15	PL/SES GS16-18	01	02	03	04	05	06	07
405	PHARMACOLOGY																							
408	ECOLOGY																							
410	ZOOLOGY																							
413	PHYSIOLOGY																							
414	ENTOMOLOGY																							
430	BOTANY																							
434	PLANT PATHOLOGY																							
435	PLANT PHYSIOLOGY																							
436	PLANT PROTECTION AND QUARANTINE																							
437	HORTICULTURE																							
440	GENETICS																							
454	RANGE CONSERVATION																							
457	SOIL CONSERVATION																							
460	FORESTRY																							
470	SOIL SCIENCE																							
471	AGRONOMY																							
480	GENERAL FISH & WILDLIFE																							

11. PLEASE LIST BY JOB SERIES AND GRADE THE LABORATORY'S AUTHORIZATION FOR NUMBER OF S&E PERSONNEL (ESTABLISHED POSITIONS WITHIN PERSONNEL CEILINGS) AND VALIDATED REQUIREMENTS AS OF 30 SEPTEMBER 1986 (END FY 1986) AND REQUIREMENTS FOR 30 SEPTEMBER 1987 (END FY 1987).

SCIENTISTS (CONT'D)		TOTAL END FY 1986		TOTAL END FY 1987		AUTHORIZATION END OF FY 1986 CIVILIAN GRADES												AUTHORIZATION END OF 1986 MILITARY GRADES						
		AUTH.	REQ.	AUTH.	REQ.	GS5	GS6	GS7	GS8	GS9	GS10	GS11	GS12	GS13	GS14	GS15	PL/SES GS16-18	01	02	03	04	05	06	07
482	FISHERY BIOLOGY																							
486	WILDLIFE BIOLOGY																							
487	HUSBANDRY																							
493	HOME ECONOMICS																							
601	GENERAL HEALTH																							
602	MEDICAL OFFICER																							
660	PHARMACIST																							
662	OPTOMETRIST																							
665	SPEECH PATHOLOGY & AUDIOLOGY																							
668	PODIATRIST																							
680	DENTAL OFFICER																							
690	INDUSTRIAL HYGIENE																							
696	CONSUMER SAFETY																							
701	VETERINARY MEDICAL SCIENCE																							
1221	PATENT ADVISER																							
1223	PATENT CLASSIFYING																							
1225	PATENT INTERFERENCE EXAMINING																							

11. PLEASE LIST BY JOB SERIES AND GRADE THE LABORATORY'S AUTHORIZATION FOR NUMBER OF S&E PERSONNEL (ESTABLISHED POSITIONS WITHIN PERSONNEL CEILINGS) AND VALIDATED REQUIREMENTS AS OF 30 SEPTEMBER 1986 (END FY 1986) AND REQUIREMENTS FOR 30 SEPTEMBER 1987 (END FY 1987).

SCIENTISTS (CONT'D)		TOTAL END FY 1986		TOTAL END FY 1987		AUTHORIZATION END OF FY 1986 CIVILIAN GRADES												AUTHORIZATION END OF 1986 MILITARY GRADES						
		AUTH.	REQ.	AUTH.	REQ.	GS5	GS6	GS7	GS8	GS9	GS10	GS11	GS12	GS13	GS14	GS15	PL/SES GS16-18	01	02	03	04	05	06	07
1226	DESIGN PATENT EXAMINING																							
1301	GENERAL PHYSICAL SCIENCE																							
1306	HEALTH PHYSICS																							
1310	PHYSICS																							
1313	GEOPHYSICS																							
1315	HYDROLOGY																							
1320	CHEMISTRY																							
1321	METALLURGY																							
1330	ASTRONOMY & SPACE SCIENCE																							
1340	METEOROLOGY																							
1350	GEOLOGY																							
1360	OCEANOGRAPHY																							
1370	CARTOGRAPHY																							
1372	GEODESY																							
1380	FOREST PRODUCTION TECHNOLGY																							
1382	FOOD TECHNOLOGY																							
1384	TEXTILE TECHNOLOGY																							
1386	PHOTOGRAPHIC TECHNOLOGY																							

11. PLEASE LIST BY JOB SERIES AND GRADE THE LABORATORY'S AUTHORIZATION FOR NUMBER OF S&E PERSONNEL (ESTABLISHED POSITIONS WITHIN PERSONNEL CEILINGS) AND VALIDATED REQUIREMENTS AS OF 30 SEPTEMBER 1986 (END FY 1986) AND REQUIREMENTS FOR 30 SEPTEMBER 1987 (END FY 1987).

SCIENTISTS (CON'D)	TOTAL END FY 1986		TOTAL END FY 1987		AUTHORIZATION END OF FY 1986 CIVILIAN GRADES												AUTHORIZATION END OF 1986 MILITARY GRADES						
	AUTH.	REQ.	AUTH.	REQ.	GS5	GS6	GS7	GS8	GS9	GS10	GS11	GS12	GS13	GS14	GS15	PL/SES GS16-18	01	02	03	04	05	06	07
1510 ACTUARY																							
1515 OPERATIONS RESEARCH																							
1520 MATHEMATICS																							
1529 MATHEMATICAL STATISTICIAN																							
1530 STATISTICIAN																							
1540 CRYPTOGRAPHY																							
1550 COMPUTER SCIENCE																							
OTHER (SPECIFY JOB SERIES & POSITION TITLE)																							
SCIENTIST SUBTOTALS																							

12. Prior studies have listed scarcity in the following occupations. What additional S&E personnel do you need to perform the work in your laboratory?

Job Series	Position Title	Number Civilian Needed	Number Military Needed	Number Authorized but Unfilled	Number Above Authorization
861	Aeronautical engineer	____	____	____	____
858	Biomedical engineer	____	____	____	____
850	Electronics engineer	____	____	____	____
855	Electronics engineer	____	____	____	____
801	General engineer	____	____	____	____
830	Mechanical engineer	____	____	____	____
840	Nuclear engineer	____	____	____	____
1320	Chemist	____	____	____	____
1310	Physicist	____	____	____	____
1350	Computer scientist	____	____	____	____
1520	Mathematician	____	____	____	____
1515	Operations research	____	____	____	____
184	Psychologist	____	____	____	____
	Other (Please specify)	____	____	____	____
____	____	____	____	____	____
____	____	____	____	____	____
____	____	____	____	____	____
____	____	____	____	____	____
____	____	____	____	____	____
____	____	____	____	____	____
____	____	____	____	____	____

13. Prior studies claim scarcity in personnel with the following multi-disciplinary backgrounds. How serious are the shortages in your laboratory for personnel with multidisciplinary skills?

SKILLS	Not Serious	Somewhat Serious	Serious	Very Serious
Acoustics	____	____	____	____
Artificial Intelligence	____	____	____	____
Biomechanics	____	____	____	____
Ceramics	____	____	____	____
Computer engineering	____	____	____	____
Computer networking	____	____	____	____
Control system engineering	____	____	____	____
Digital Communications	____	____	____	____
Fiber optics	____	____	____	____
Geophysics	____	____	____	____
Human factors	____	____	____	____
Infrared manufacturing engineering	____	____	____	____
Ocean engineering	____	____	____	____
Physical chemistry	____	____	____	____
Robotics	____	____	____	____
Signal processing	____	____	____	____
Systems engineering	____	____	____	____
Telecommunications	____	____	____	____
Weapons design	____	____	____	____
Other (Please Specify)	____	____	____	____
____________	____	____	____	____
____________	____	____	____	____

14. How many of your laboratory's S&E professionals holding grades GS/GM 13 and above are supervisors and how many are not supervisors?

Grade	Number of Supervisors	Number of Non-Supervisors
GS/GM 13	________	________
GS/GM 14	________	________
GS/GM 15	________	________
GS-16-18	________	________
SES	________	________
PL	________	________

15. Describe your policies for promoting S&E professionals to high grades (GS/GM13 through PL/SES) without supervisory responsibilities.

VACANCIES AND DEPARTURES

16. REFLECT S&E POSITIONS UNFILLED BY S&E'S AS OF 30 SEPTEMBER 1986 (END FY 1986). IDENTIFY BY JOB SERIES OR SPECIALTY CODE AND GRADE (ACTUAL NUMBERS). PLEASE USE FOLLOWING DEFINITION OF VACANCIES.

VACANCIES - UNFILLED S&E BILLETS/SLOTS/POSITIONS PREVIOUSLY FILLED BY AN S&E INDIVIDUAL OR UNINTENDED TO BE FILLED BY AN S&E. WHEN AN ACTIVITY IS "MANNED" TO ITS CEILING ON 30 SEPTEMBER 1986 WITH OTHER THAN S&E INDIVIDUALS BECAUSE SUFFICIENT S&E PERSONNEL CANNOT BE RECRUITED/HIRED. THOSE S&E BILLETS/SLOTS/POSITIONS SHOULD STILL BE CONSIDERED VACANT (UNFILLED) FOR THE PURPOSE OF THIS QUESTIONNAIRE.

END FY 1986
UNFILLED POSITIONS (NUMBERS)

ENGINEERS	CIVILIAN												MILITARY						
	GS5	GS6	GS7	GS8	GS9	GS10	GS11	GS12	GS13	GS14	GS15	PL/SES GS16-18	01	02	03	04	05	06	07
801 GENERAL ENGINEERING																			
803 SAFETY ENGINEERING																			
804 FIRE PREVENTION ENGINEERING																			
806 MATERIALS ENGINEERING																			
807 LANDSCAPE ARCHITECTURE																			
808 ARCHITECTURE																			
810 CIVIL ENGINEERING																			
819 ENVIRONMENTAL ENGINEERING																			
830 MECHANICAL ENGINEERING																			
840 NUCLEAR ENGINEERING																			
850 ELECTRICAL ENGINEERING																			
855 ELECTRONICS ENGINEERING																			
858 BIOMEDICAL ENGINEERING																			
861 AERONAUTICS ENGINEERING																			
871 NAVAL ARCHITECTURE																			
880 MINING ENGINEERING																			

VACANCIES AND DEPARTURES

16. REFLECT S&E POSITIONS UNFILLED BY S&E'S AS OF 30 SEPTEMBER 1986 (END FY 1986). IDENTIFY BY JOB SERIES OR SPECIALTY CODE AND GRADE (ACTUAL NUMBERS). PLEASE USE FOLLOWING DEFINITION OF VACANCIES.

END FY 1986
UNFILLED POSITIONS (NUMBERS)

ENGINEERS (CONT'D)	CIVILIAN												MILITARY						
	GS5	GS6	GS7	GS8	GS9	GS10	GS11	GS12	GS13	GS14	GS15	PL/SES GS16-18	01	02	03	04	05	06	07
881 PETROLEUM PRODUCTION & NATURAL GAS ENGINEERING																			
890 AGRICULTURE ENGINEERING																			
892 CERAMIC ENGINEERING																			
893 CHEMICAL ENGINEERING																			
894 WELDING ENGINEERING																			
896 INDUSTRIAL ENGINEERING																			
OTHER (SPECIFY JOB SERIES & POSITION TITLE)																			

VACANCIES AND DEPARTURES

16. REFLECT S&E POSITIONS UNFILLED BY S&E'S AS OF 30 SEPTEMBER 1986 (END FY 1986). IDENTIFY BY JOB SERIES OR SPECIALTY CODE AND GRADE (ACTUAL NUMBERS). PLEASE USE FOLLOWING DEFINITION OF VACANCIES.

END FY 1986
UNFILLED POSITIONS (NUMBERS)

SCIENTISTS	CIVILIAN												MILITARY						
	GS5	GS6	GS7	GS8	GS9	GS10	GS11	GS12	GS13	GS14	GS15	PL/SES GS16-18	01	02	03	04	05	06	07
101 SOCIAL SCIENCE																			
150 GEOGRAPHY																			
184 PSYCHOLOGY																			
190 GENERAL ANTHROPOLOGY																			
193 ARCHEOLOGY																			
401 GENERAL BIOLOGY																			
403 MICROBIOLOGY																			
405 PHARMACOLOGY																			
408 ECOLOGY																			
410 ZOOLOGY																			
413 PHYSIOLOGY																			
414 ENTOMOLOGY																			
430 BOTANY																			
434 PLANT PATHOLOGY																			
435 PLANT PHYSIOLOGY																			
436 PLANT PROTECTION AND QUARANTINE																			
437 HORTICULTURE																			

VACANCIES AND DEPARTURES

16. REFLECT S&E POSITIONS UNFILLED BY S&E'S AS OF 30 SEPTEMBER 1986 (END FY 1986). IDENTIFY BY JOB SERIES OR SPECIALTY CODE AND GRADE (ACTUAL NUMBERS). PLEASE USE FOLLOWING DEFINITION OF VACANCIES.

END FY 1986
UNFILLED POSITIONS (NUMBERS)

SCIENTISTS (CONT'D)	CIVILIAN												MILITARY						
	GS5	GS6	GS7	GS8	GS9	GS10	GS11	GS12	GS13	GS14	GS15	PL/SES GS16-18	01	02	03	04	05	06	07
440 GENETICS																			
454 RANGE CONSERVATION																			
457 SOIL CONSERVATION																			
460 FORESTRY																			
470 SOIL SCIENCE																			
471 AGRONOMY																			
480 GENERAL FISH & WILDLIFE																			
482 FISHERY BIOLOGY																			
486 WILDLIFE BIOLOGY																			
487 HUSBANDRY																			
493 HOME ECONOMICS																			
601 GENERAL HEALTH																			
602 MEDICAL OFFICER																			
660 PHARMACIST																			
662 OPTOMETRIST																			
665 SPEECH PATHOLOGY & AUDIOLOGY																			

VACANCIES AND DEPARTURES

16. REFLECT S&E POSITIONS UNFILLED BY S&E'S AS OF 30 SEPTEMBER 1986 (END FY 1986). IDENTIFY BY JOB SERIES OR SPECIALTY CODE AND GRADE (ACTUAL NUMBERS). PLEASE USE FOLLOWING DEFINITION OF VACANCIES.

END FY 1986
UNFILLED POSITIONS (NUMBERS)

SCIENTISTS (CONT'D)		CIVILIAN												MILITARY						
		GS5	GS6	GS7	GS8	GS9	GS10	GS11	GS12	GS13	GS14	GS15	PL/SES GS16-18	01	02	03	04	05	06	07
668	PODIATRIST																			
680	DENTAL OFFICER																			
690	INDUSTRIAL HYGIENE																			
696	CONSUMER SAFETY																			
701	VETERINARY MEDICAL SCIENCE																			
1221	PATENT ADVISER																			
1223	PATENT CLASSIFYING																			
1225	PATENT INTERFERENCE EXAMINING																			
1226	DESIGN PATENT EXAMINING																			
1301	GENERAL PHYSICAL SCIENCE																			
1306	HEALTH PHYSICS																			
1310	PHYSICS																			
1313	GEOPHYSICS																			
1315	HYDROLOGY																			
1320	CHEMISTRY																			
1321	METALLURGY																			

VACANCIES AND DEPARTURES

16. REFLECT S&E POSITIONS UNFILLED BY S&E'S AS OF 30 SEPTEMBER 1986 (END FY 1986). IDENTIFY BY JOB SERIES OR SPECIALTY CODE AND GRADE (ACTUAL NUMBERS). PLEASE USE FOLLOWING DEFINITION OF VACANCIES.

END FY 1986
UNFILLED POSITIONS (NUMBERS)

SCIENTISTS (CONT'D)	CIVILIAN												MILITARY						
	GS5	GS6	GS7	GS8	GS9	GS10	GS11	GS12	GS13	GS14	GS15	PL/SES GS16-18	01	02	03	04	05	06	07
1330 ASTRONOMY & SPACE SCIENCE																			
1340 METEOROLOGY																			
1350 GEOLOGY																			
1360 OCEANOGRAPHY																			
1370 CARTOGRAPHY																			
1372 GEODESY																			
1380 FOREST PRODUCTION TECHNOLGY																			
1382 FOOD TECHNOLOGY																			
1384 TEXTILE TECHNOLOGY																			
1386 PHOTOGRAPHIC TECHNOLOGY																			
1510 ACTUARY																			
1515 OPERATIONS RESEARCH																			
1520 MATHEMATICS																			
1529 MATHEMATICAL STATISTICIAN																			
1530 STATISTICIAN																			
1540 CRYPTOGRAPHY																			
1550 COMPUTER SCIENCE																			
OTHER (SPECIFY JOB SERIES & POSITION TITLE)																			

17. Using a scale from 0 to 9, please rate how influential you believe that each of the following reasons was in your S&E personnels decisions to accept jobs (e.g., transfer, industry, school) outside your laboratory during the FY 1986 (0 stands for not influential, 4.5 for moderately influential and 9 stands for very influential).

Not Influential				Moderately Influential					Very Influential
0	1	2	3	4	5	6	7	8	9

FY 1986 Departures

	Civilian			Military
	Under GS12	GS12	Over GS12	
Type of work	___	___	___	___
Opportunity for advancement elsewhere	___	___	___	___
Lack of opportunity for advancement in lab	___	___	___	___
Location of employment	___	___	___	___
Salary Increase	___	___	___	___
Perceived reduction in federal benefits	___	___	___	___
Opportunity for continued education	___	___	___	___
Lack of appropriate clerical/ technical support	___	___	___	___
Job security	___	___	___	___
Better total compensation package	___	___	___	___
Time spent in non-engineering/ non-scientific duties	___	___	___	___
Other (specify)___	___	___	___	___
___	___	___	___	___
___	___	___	___	___

RECRUITMENT AND RETENTION

18. How long has it generally been taking your laboratory to accomplish the following personnel actions for all S&E reporting during FY 1986?

Average Days to Accomplish Actions by Category

	LEVEL			
Category	**GS5-7**	**GS9-12**	**GS13-15**	**PL/SES/GS16-18**
Internal Processing Prior to Advertising	____	____	____	____
From Advertisement to Beginning of Review Process	____	____	____	____
Review and Selection Process	____	____	____	____
Approval Above Laboratory Level	____	____	____	____
From Final Approval to Employee Reports to Work	____	____	____	____

19. Please indicate the effectiveness of the following methods of recruiting civilian S&E's.

Not Effective				Moderately Effective					Very Effective
0	1	2	3	4	5	6	7	8	9

	Entry Level	Journeyman
Experimental Programs		
Federal Junior Fellowship Program	____	____
Co-op Programs	____	____
Student Volunteer:Trainee programs	____	____
Intership programs	____	____
Minority Programs	____	____
Research contracts with universities for services of S&E students	____	____
Academic interchange program (e.g., summer faculty, "postdoc programs)	____	____
Outreach Activities		
Newspaper/Technical Journal Ads	____	____
Visits to Schools	____	____
Visits to Industry	____	____
Visits to Minority Schools	____	____
Follow-up Interviews/Tours at Lab	____	____
Peer Review	____	____
Recruitment at Professional Meetings	____	____
Personal contact between potential employee and S&E's already on-board	____	____

20. What is the rejection rate of offers (formal and informal) made to S&E selectees during FY1986 by the following grade categories?

GS5-7 _____%	GS-13 _____%	GS16-18 _____%
GS9-11 _____%	GS-14 _____%	PL _____%
GS-12 _____%	GS-15 _____%	SES _____%

21. Using a scale from 0 to 9, please rate the importance of the following factors for taking a job in the laboratory and for retaining a job in the laboratory.

No Importance			Moderately Important					Very Important	
0	1	2	3	4	5	6	7	8	9

	Recruitment		Retention	
	Take Position	Don't Take Position	Stay	Leave
Location of Employment	____	____	____	____
Facility near transportation	____	____	____	____
Affordable housing nearby	____	____	____	____
Cost of living in locality	____	____	____	____
Type of Work	____	____	____	____
Training Opportunities	____	____	____	____
Opportunity for Advancement	____	____	____	____
Proximity to Competing Industry/ Government	____	____	____	____
Reputation of Laboratory	____	____	____	____
Salary	____	____	____	____
Modern Facilities	____	____	____	____
Opportunity for Continued Education	____	____	____	____
Job Security	____	____	____	____
Up-to-date Equipment	____	____	____	____
Use of skills	____	____	____	____
Proximity to Universities	____	____	____	____
Lack of other offers	____	____	____	____
Reputation of Civil Service	____	____	____	____

22. What is the grade distribution of new civilian S&E personnel acquired during FY1986?

Grade	Number
GS5-7	____
GS9-11	____
GS-12	____
GS-13	____
GS-14	____
GS-15	____
SES	____
PL	____
GS-16-18	____

23. During FY1986 how many civilian S&E vacancies were filled by hire or transfer:

	Number				
	Non-Federal New Hire	Federal Reassignment or Transfers	Merit Promotion Within Laboratory	Persons Without S&E Degree	Total
GS5-7	____	____	____	____	____
GS7-9	____	____	____	____	____
GS9-11	____	____	____	____	____
GS-12	____	____	____	____	____
GS-13	____	____	____	____	____
GS-14	____	____	____	____	____
GS-15	____	____	____	____	____
GS16-18	____	____	____	____	____
SES	____	____	____	____	____
PL	____	____	____	____	____

24. Please give the percentage of S&E civilian hires (during FY 1986) with newly acquired baccalaureate degrees that graduated in the top, second, third, and bottom quarters of their college class.

	Top Quarter	Second Quarter	Third Quarter	Bottom Quarter
Scientists	____	____	____	____
Engineers	____	____	____	____

25. Please assess the quality of S&E personnel recruited during the last year as compared to that of five and ten years ago.

	5 Years Ago			10 Years Ago		
	Worse	Same	Better	Worse	Same	Better
Academic Preparation	____	____	____	____	____	____
Adjustment to job	____	____	____	____	____	____
Time required to assume position responsibilities	____	____	____	____	____	____
Attitudes toward working	____	____	____	____	____	____
Attitude toward a career inFederal service	____	____	____	____	____	____

26. How many (numbers) S&E's left your lab during FY86?

Civilians ______ Military ______

27. How many civilian S&E's of the various grades left for the following reasons?

Reason	Number Of Departures by Grade								
	GS 5	7	9	11	12	13	14	15	Total
Retired	___	___	___	___	___	___	___	___	___
Deceased, illness	___	___	___	___	___	___	___	___	___
Transferred to another DoD lab	___	___	___	___	___	___	___	___	___
Transferred to a non-lab DoD agency	___	___	___	___	___	___	___	___	___
Work in industry	___	___	___	___	___	___	___	___	___
Work in educational institution	___	___	___	___	___	___	___	___	___
Departed for additional education	___	___	___	___	___	___	___	___	___
Other (please specify)	___	___	___	___	___	___	___	___	___
______________	___	___	___	___	___	___	___	___	___
______________	___	___	___	___	___	___	___	___	___

PERSONNEL AND WORK IMPACTS

28. How serious are the following problems and impacts in your laboratory and what are the reasons for these? Please place the appropriate number (from 0 signifying not serious, 4.5 moderately serious, to 9 signifying very serious) under each reason. There should be a number placed on each line below or N/A if not applicable.

RATING SCALE 0 1 2 3 4 5 6 7 8 9

Not Serious — Moderately Serious — Very Serious

Problems and Impacts	Authorization Ceilings	Limited High Grade Positions (GS13-15)	Salary Limitations	Unfilled S&E Positions	Bureaucratic Constraints	Finding People With Appropriate Skills	Fluctuating Work Load	Changin Technol ogies
PERSONNEL								
Recruitment of S&E's	____	____	____	____	____	____	____	____
Retention of S&E's	____	____	____	____	____	____	____	____
Increased S&E workload	____	____	____	____	____	____	____	____
Low S&E morale	____	____	____	____	____	____	____	____
Assignment of lower grade people to higher grade work	____	____	____	____	____	____	____	____
Assignment of higher grade people to lower grade work	____	____	____	____	____	____	____	____
Reduction of in-house expertise	____	____	____	____	____	____	____	____
Inability to promote deserving people	____	____	____	____	____	____	____	____

28. (Continued) RATING SCALE

0	1	2	3	4	5	6	7	8	9
Not Serious				Moderately Serious				Very Serious	

Problems and Impacts	Authorization Ceilings	Limited High Grade Positions (GS13-15)	Salary Limitations	Unfilled S&E Positions	Bureaucratic Constraints	Finding People With Appropriate Skills	Fluctuating Work Load	Changing Technologies
PERSONNEL (Cont.)								
Increased use of temporary people	___	___	___	___	___	___	___	___
Inability to hire experienced people	___	___	___	___	___	___	___	___
Increased on-site contractors	___	___	___	___	___	___	___	___
Technician shortage	___	___	___	___	___	___	___	___
Other (specify) ______ ______________	___	___	___	___	___	___	___	___
WORK RELATED								
Work Delays	___	___	___	___	___	___	___	___
Unable to respond to unprogrammed requests	___	___	___	___	___	___	___	___
Inadequate manning levels	___	___	___	___	___	___	___	___
Unable to respond to requests for work	___	___	___	___	___	___	___	___
Increased contracting out	___	___	___	___	___	___	___	___

28. (Continued)

RATING SCALE 0 1 2 3 4 5 6 7 8 9

Not Serious — Moderately Serious — Very Serious

Problems and Impacts	Authorization Ceilings	Limited High Grade Positions (GS13-15)	Salary Limitations	Unfilled S&E Positions	Bureaucratic Constraints	Finding People With Appropriate Skills	Fluctuating Work Load	Changin Technol ogies
WORK RELATED (Cont.)								
Cannot satisfy customer demand	____	____	____	____	____	____	____	____
Loss of specific technical capabilities	____	____	____	____	____	____	____	____
No t'me to address critical problems	____	____	____	____	____	____	____	____
Decrease in work quality	____	____	____	____	____	____	____	____
Decrease in work supervision	____	____	____	____	____	____	____	____
Increased technical risk	____	____	____	____	____	____	____	____

TRAINING

29. During the past 5 years, what percentage of your civilian and military S&E's participated in government-sponsored training programs?

	Less than a week	1-4 weeks	1-6 months	6+ months
Civilian S&E	____%	____%	____%	____%
Military S&E	____%	____%	____%	____%

30. During the past 3 years, what percentage of your scientists and engineers attended the following types of training programs of various sites?

	Less than a week	1-4 weeks	1-6 months	6+ months
Types of Training				
Scientific and skills training	____%	____%	____%	____%
Management skills	____%	____%	____%	____%
Executive development	____%	____%	____%	____%
Supervisory training	____%	____%	____%	____%
Other (specify)________	____%	____%	____%	____%
____________________	____%	____%	____%	____%
____________________	____%	____%	____%	____%
____________________	____%	____%	____%	____%
Sites of Training				
In-house	____%	____%	____%	____%
University	____%	____%	____%	____%
Contract	____%	____%	____%	____%
Other government	____%	____%	____%	____%
Other (specify)________	____%	____%	____%	____%
____________________				

31. Does your lab have any arrangements with nearby or other universities or colleges to provide graduate or postgraduate technical engineering and scientific education for lab personnel? Yes _____ No _____

32. If yes, does the completion of such courses convey academic credit?

Yes _____ No _____

33. If these arrangements include cost sharing, what portion is borne by the lab? (Assume that the employee completes requirements for the MS or equivalent degree.) Circle answer.

a. 50% or less

b. 51% to 75%

c. 76% to 90%

d. 91% to 99%

e. 100%

34. Does the existing prohibition against paying the costs of training for the sole or primary purpose of achieving an academic degree pose a particular problem? Yes _____ No _____

35. If yes, in what aspect? (Check as many as apply.)

_____ a. Recruitment

_____ b. Retention

_____ c. Grievances

_____ d. Other (Please describe) ____________________

____

36. Are you able to provide the training necessary to keep your S&E's current in their field? Yes _____ No _____

If no, please explain. ____________________

____

37. What types of training activities are available for your employees to keep them current? (Check as many as apply.)

_____ a. Academic courses

_____ b. Symposia and conferences

_____ c. Participation in professional S&E societies (e.g., IEEE, American Checmical Society)

_____ d. Others? (Please explain)_______________________________

____

38. What types of training activities need greater emphasis or greater availability at your lab? (Check as many as apply)

_____ a. Academic courses

_____ b. Symposia and conferences

_____ c. Participation in professional S&E societies

_____ d. Others? (Please explain)_______________________________

____

39. Which of the following represents the <u>most</u> significant difficulty faced in providing needed training for scientists and engineers. (Check only <u>one</u> item and explain in space provided.)

____ a. Inadequate funding.

____ b. Problems with training policies.

____ c. Problems with administrative training procedures.

____ d. Lack of satisfactory training sources (e.g., universities, vendors.)

____ e. Insufficient time for training due to work load or similar demands.

____ f. Inadequate managerial support either locally or higher levels.

____ g. Getting S&Es interested in advanced training and education.

____ h. Other practices (please specity) ____________________

____

____ i. No significant problems.

Please explain your choice: ____________________________

____

____

LABORATORY DIRECTOR SUMMARY QUESTIONS

40. How is SES system working? Please include in your answer rotation and merit pay issues.

41. Identify any aspect of policy, procedures, management, or organization, that impact on your ability to resolve S&E problems.

42. Provide a summary narrative assessing the S&E personnel status, concerns, or issues from the perspective of your activity (current and projected). Add any observations not identified elsewhere. Please provide your recommendations for the resolution of the concerns and issues you have expressed about the scientists, engineers, and skilled technicians.