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ABSTRACT

The impact that trends in faculty positions may have on science in the United States is examined in this paper. Evidence is presented that indicates that there is a need to create new junior faculty positions on our university campuses. Three possible complementary approaches to alleviating the shortage of positions available to the increasing number of young faculty are discussed: voluntary early retirement, voluntary mid-career change, and Senior Scientists Research Grants. (Author/JMF)

TRENDS IN FACULTY POSITIONS AND THEIR IMPACT ON U.S. SCIENCE

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This paper examines the impact that trends in faculty positions may have on science in the United States. Evidence is presented that indicates that there is a need to create new junior faculty positions on our university campuses. Three possible complementary approaches to alleviating this situation are discussed: voluntary early retirement, voluntary mid-career change, and Senior Scientists Research Grants

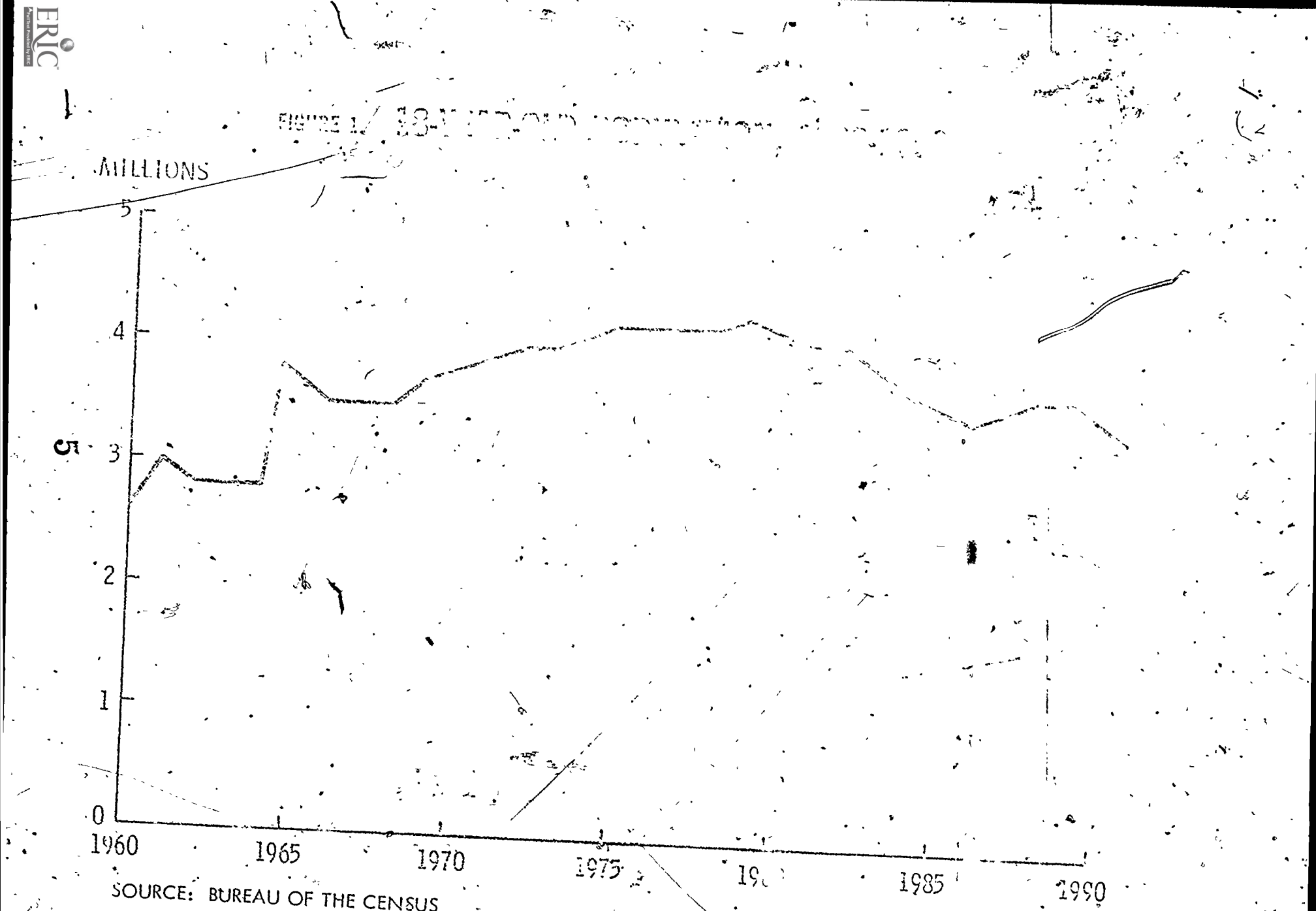
In fall 1975, total enrollment in American colleges and universities was over 11 million, a record number; but an end to the period of enrollment growth seems in sight. It is expected that enrollment in higher education will peak about 1980 and thereafter begin to decline.

As for college and university faculty, however, there is less concern about overall numbers than about trends in age distribution. Faculty are becoming, on the average, older. For faculty in science and engineering fields in doctorate-granting institutions, the median age rose from 40 to 44 years between 1969 and 1973. Not surprisingly, the proportion of faculty with tenure is also rising.

In light of these trends, there is concern about maintaining the vitality of the research and teaching base in colleges and universities. Among the possible courses of action that we should consider is the need for creating new junior faculty positions on our university campuses. Before turning to that issue, it is helpful to look briefly at enrollments, the major driving force behind the growth of higher education in the 1960's and one of the reasons for anticipated problems ahead.

Much of the growth in higher education during the last decade and a half was in response to demographic factors. The number of 18-year-olds is now more than 60 percent greater than in 1960. However, as shown in Figure 1 which is based on numbers of children already born, the peak of the demographic trend has almost been reached. In 1979 the number of 18-year-olds is expected to total just under 4.3 million. Afterwards, the number decreases each year. By 1990, just eleven years later, the number is projected to be down over 20 percent. The demographic trend for the 18 to 21 year olds, the traditional undergraduate age group, are similar--peaking in 1979 and declining thereafter. The number of 23-year-olds, the traditional reference group for graduate school entrants, is expected to continue to increase through 1984 and then to begin to decline.[1]

1/ Department of Commerce, Bureau of the Census, Population Estimates and Projections, Series P-25, Numbers 519, 541, and 614, (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office), 1974 and 1975.



SOURCE: BUREAU OF THE CENSUS

Not surprisingly, total degree-credit enrollment in all fields in four-year colleges and universities is expected to peak in 1980 at about 7.4 million, with about 20 percent of the enrollment being graduate students. Enrollments are projected to decline thereafter.[2]

The National Science Foundation has made projections of enrollment for advanced degrees in science and engineering fields.[3] According to the projection believed to be most likely--it gives double weight to the trends of recent years--total enrollment for advanced degrees in science and engineering is expected to be about 210 thousand by 1985, about 15 percent below the peak reached in 1970.

Enrollment for advanced degrees in the physical sciences reached a high of 41 thousand in 1968 and by 1973 had declined by 12 percent. This decline is expected to continue, according to the NSF probable projection, with the 1985 figure projected to be about 55 percent below the 1968 figure.

The expected production and utilization of doctoral scientists and engineers in 1985 is also worthy of attention. Based on recent projections by both NSF and the Bureau of Labor Statistics, there is

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2/ Department of Health, Education, and Welfare, National Center for Education Statistics, Projections of Education Statistics to 1984-85, (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office), 1976.

3/ National Science Foundation, Projections of Degrees and Enrollment in Science and Engineering Fields to 1985 (NSF 76-301), (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office),1976.

expected to be a more than adequate supply of doctorates in science and engineering, although spot shortages may occur in some specialized subfields. According to the Probable projection in the Foundation's study, total science and engineering faculty in four-year colleges and universities could drop to about 230 thousand in 1985, a decline of 7 percent from the 1972 level. In the case of physical sciences faculty, their numbers could drop by about 25 percent during the 1972-1985 period.[4]

According to a biennial NSF survey about 80 percent of the doctoral physical scientists employed by four-year colleges and universities were under age 50 and nearly 95 percent were under age 60 in 1973. For physicists and astronomers, as Figure 2 shows, 83 percent were under 50 and over 95 percent under 60 in 1973.[5] Inherent in these age distribution data is an implication that the pattern over the next decade or longer will be that of a relatively senior faculty, most of whom will be tenured. Data from the Foundation's 1975 survey are now being processed and will be available this summer.

As mentioned above, a substantial proportion of full-time faculty have tenure. An NSF study conducted in 1974 of 126 selected doctorate-level physics departments found that 78 percent of the faculty were tenured. Of the 15 fields surveyed only chemical engineering reported a higher proportion of tenured faculty. For all the science and engineering fields

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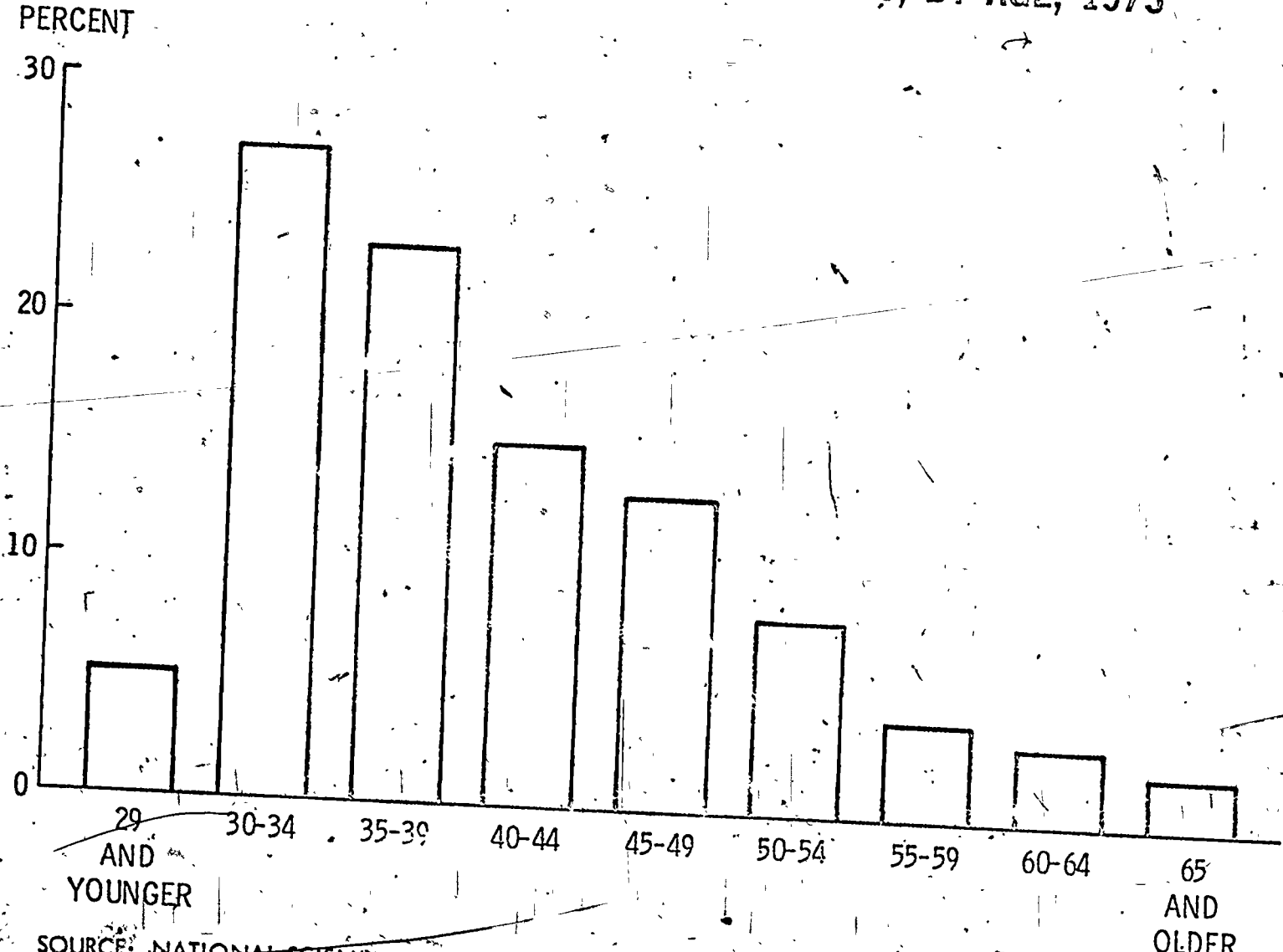
4/ National Science Foundation, Projections of Science and Engineering Doctorate Supply and Utilization, 1980 and 1985 (NSF 75-301), Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office), 1975.

5/ National Science Foundation, Characteristics of Doctoral Scientists and Engineers in the United States, 1973, Detailed Statistical Tables, Appendix B, (NSF 75-312-A), (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office), 1975.

FIGURE 2. DOCTORATE PHYSICISTS AND ASTRONOMERS EMPLOYED BY FOUR-YEAR COLLEGES AND UNIVERSITIES, BY AGE, 1973



SOURCE: NATIONAL SCIENCE FOUNDATION

surveyed, 70 percent of the faculty had tenure.[6]

This same NSF study found that between 1968 and 1974 the proportion of young doctorate faculty in physics departments dropped by from 38 percent to 18 percent. (The study defined "young faculty" as those who had held the doctorate for seven years or less). By comparison, the proportion of young doctorate faculty in chemistry departments declined from 34 percent to 21 percent between 1968 and 1974; for mathematics departments, the proportion dropped from 47 percent to 35 percent.

How does this situation compare in the "Top 10" versus the "Good" departments identified from the Roose-Andersen survey?[7] The "Top Ten" physics departments for which data were available for both 1968 and 1974 are compared with an equal number of "Good" departments in Figure 3. (The "Good" departments were those ranking, roughly, between thirtieth and fiftieth). In 1968, the proportion of young doctorate faculty in the "Top Ten" "Distinguished and Strong" physics departments for which we had data was 38 percent; by 1974, the proportion had dropped by over one-third to 24 percent. For the "Good" physics departments the drop was much sharper, from 35 percent in 1968 to 10 percent in 1974. Both groups of departments were fairly close together in 1968 in the proportion of young faculty, both lost

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6/ National Science Foundation, Young and Senior Science and Engineering Faculty, 1974: Support, Research Participation, and Tenure, (NSF 75-302) (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office), 1975.

7/ Kenneth D. Roose and Charles J. Andersen, A Rating of Graduate Programs, (Washington, D.C: American Council on Education), 1970.

FIGURE 3. PROPORTION OF YOUNG DOCTORATE FACULTY[1/] IN SELECTED ROOSE-ANDERSEN-RATED DEPARTMENTS, BY FIELD, 1968 AND 1974, AND PROPORTION OF TENURED FACULTY IN THESE DEPARTMENTS, 1974

FIELD AND QUALITY GROUP	PERCENT OF YOUNG DOCTORATE FACULTY		PERCENT OF TENURED FACULTY
	1968	1974	1974
PHYSICS			
10 "DISTINGUISHED AND STRONG" DEPARTMENTS	38	24	73
10 "GOOD" DEPARTMENTS	35	10	83
CHEMISTRY			
10 "DISTINGUISHED AND STRONG" DEPARTMENTS	37	22	72
10 "GOOD" DEPARTMENTS	36	20	77
MATHEMATICS			
10 "DISTINGUISHED AND STRONG" DEPARTMENTS	50	32	69
10 "GOOD" DEPARTMENTS	49	26	75

1/ HAVE HELD DOCTORATE FOR 7 YEARS OR LESS.

SOURCE: NATIONAL SCIENCE FOUNDATION

young faculty between 1968 and 1974, but the "Good" physics departments suffered the greater loss. The ten "Good" departments also had a substantially higher level of tenured faculty in 1974 than did the "Top 10", 83 percent compared to 73 percent.

The situation in chemistry and mathematics, however, was somewhat different. Again comparing the "Top 10" departments and ten "Good" departments in each field, one finds in 1968 almost no difference between the two sets of departments. By 1974 in both fields the proportion of young doctorate faculty had dropped to roughly 60 percent of the 1968 level. Chemistry and mathematics differed from physics in that the decline in the proportion of young faculty in "Good" departments in these two fields was not very much different from the decline experienced by the "Top 10" departments. In physics, it may be remembered, the "Good" departments had a much sharper decrease than did the "Top 10" departments. With respect to tenure, however, the situation in chemistry and mathematics was similar to that already noted in physics. In all three fields, the "Good" departments reported higher proportions of tenured faculty than did the "Top 10" departments.

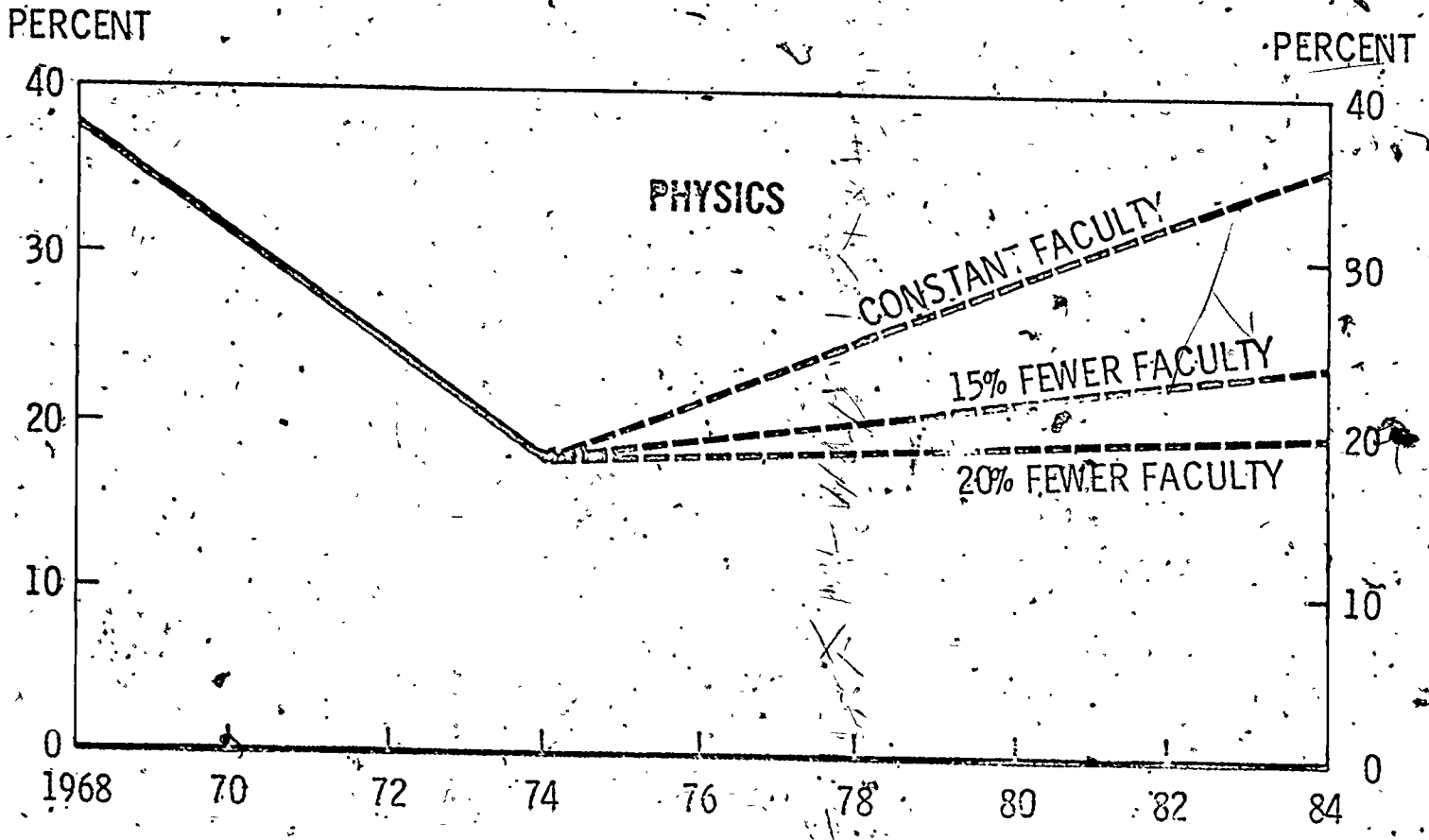
Taking into account the factors just discussed, namely, the projected decrease in physical sciences faculty by 1985, the age distribution of physics faculty members, and the current proportion of young doctorate faculty in physics departments, it is obvious there will not be many places for additional young faculty if traditional staffing practices are followed.

It is possible to change staffing practices to increase the proportion of young doctorate faculty. The most drastic change would be to fill all vacancies in the ranks of senior faculty with young doctorates and to retain no young faculty for more than seven years past the doctorate. Admittedly, such a policy would probably never be adopted but it would result in a steady rise in the proportion of young doctorate faculty, provided that the overall size of faculty remained constant. In this connection, it is interesting to look at projections specifically for physics departments made by Dr. Charles E. Falk, Director of the National Science Foundation's Division of Science Resources Studies, based on data from our 1974 faculty study. Dr. Falk's assumptions differed from those stated above in one respect--the 16 percent of young physics faculty who had tenure in 1974 were retained--all other young faculty did not stay for more than seven years past the doctorate. Then, assuming the size of the physics faculty were to remain constant and all vacancies of senior faculty due to attrition were filled by young doctorate faculty, the proportion of young faculty in physics departments would rise to 35 percent in 1984, as shown by the upper dashed line in Figure 4. The 1968 proportion of young doctorate faculty was 38 percent.

Projections using the same assumptions except the one pertaining to constant faculty size are shown by the two lower lines in Figure 4. If one assumes that total physics faculty will be reduced by 15 percent, some increase in the proportion of young doctorate faculty in 1984 will be possible. With a 20 percent reduction, there would be almost no change in the ratio of young to senior faculty over the 1974-1984 period.

FIGURE 4. YOUNG FACULTY AS PROPORTION OF TOTAL FACULTY, BY TOTAL FACULTY SIZE

(ALL SENIOR FACULTY ATTRITION REPLACED BY YOUNG FACULTY; ONLY TENURED YOUNG FACULTY RETAINED)



SOURCE: NATIONAL SCIENCE FOUNDATION, DIVISION OF SCIENCE RESOURCES STUDIES

Parenthetically, it is obvious that morale problems would be acute among young faculty who know there is no chance of getting a permanent position in their department. That, in turn, may be expected to diminish research vitality.

Evidence from a recent Higher Education Panel survey, which is discussed more fully below, indicates that the "most desirable" proportion of young doctorate faculty in the opinion of physics department heads is 27 percent.[8/] Since the level of young faculty in 1984 under Dr. Falk's first projection could reach 35 percent, it appears that some additional young faculty can be retained besides those who already had tenure. Specifically, if the goal is to have 27 percent young doctorate physics faculty in 1984, about 20 percent of the young faculty in residence at universities between 1974 and 1984 could be given permanent positions if one assumes a four-year turnover rate for young faculty. Here it is also assumed, of course, that the overall size of physics faculty will remain constant and that the vacated senior positions would be filled by young doctorates.

8/ Frank J. Atelsek and Irene L. Gomberg, Status of Young Doctorate Faculty in Selected Science and Engineering Departments, 1975 to 1980, (Washington, D.C.: American Council on Education, Higher Education Panel), 1976 (in preparation).

The Higher Education Panel survey mentioned above does not present an encouraging picture of the current situation. This survey, like the 1974 NSF survey, was directed to department heads. In the 89 physics departments that responded to both the 1974 NSF survey and recent HEP survey, the proportion of young doctorate faculty had dropped from 19 percent in May, 1974, to 17 percent in December, 1975. Furthermore, the department heads estimated that in 1980 the proportion of young faculty in physics would be down to 15 percent. The projections were roughly the same in the top departments and in the sample as a whole.

Two-thirds of the responding physics department heads stated that the proportion of young faculty in their departments is now too low. By 1980 four out of five physics department heads believe that the figure will be too low. The survey also asked the department heads' opinions about what would be the "most desirable" percentage of young doctorate faculty. As Figure 5 shows, the "most desirable" figure was 27 percent while the actual was 17 percent. By comparison, chemistry departments had 21 percent young doctorate faculty; this was below the "most desirable" level of 26 percent. On the other hand, mathematics departments in 1975 were at the level considered "most desirable", 31 percent.

In the "Distinguished and Strong" departments the 1975 proportions of young doctorate faculty, particularly in mathematics, were below the overall levels for all responding departments in their respective disciplines. The heads of these departments essentially agreed with their counterparts at other institutions in their estimates of the "most desirable" percentages.

FIGURE 5. COMPARISON OF 1975 ACTUAL PROPORTION OF YOUNG DOCTORATE FACULTY[1] WITH DEPARTMENT HEADS' OPINION OF "MOST DESIRABLE" PROPORTION OF THESE FACULTY, FOR ALL DEPARTMENTS AND "DISTINGUISHED AND STRONG" (ROOSE-ANDERSEN) DEPARTMENTS, BY FIELD

FIELD AND QUALITY GROUP	ACTUAL PROPORTION OF YOUNG DOCTORATE FACULTY 1975	"MOST DESIRABLE" PROPORTION OF YOUNG DOCTORATE FACULTY
PHYSICS		
97 DEPARTMENTS	17	27
20 "DISTINGUISHED AND STRONG" DEPARTMENTS	16	25
CHEMISTRY		
114 DEPARTMENTS	21	26
32 "DISTINGUISHED AND STRONG" DEPARTMENTS	20	25
MATHEMATICS		
99 DEPARTMENTS	31	31
17 "DISTINGUISHED AND STRONG" DEPARTMENTS	26	32

1/ HAVE HELD DOCTORATE FOR 7 YEARS OR LESS.

SOURCE: NATIONAL SCIENCE FOUNDATION AND AMERICAN COUNCIL ON EDUCATION

Based on the evidence, I believe there is the need for creating new junior faculty positions on our university campuses. How is this to be done? One approach is to encourage early retirements. The previously mentioned HEP survey indicated considerable support for this course. Furthermore, as the TIAA-CREF reported in January 1976, over the past decade increasing proportions of retiring participants have been starting their TIAA annuity income at earlier ages. The proportion starting their annuity income before age 60 rose from under 5 percent in 1966 to nearly 10 percent in the first eleven months of 1975.[9]

Why consider early retirement plans for faculty? As I have already observed, the future capacity of our colleges and universities to hire young scientists is limited both by the projected turndown in enrollments and by the fact that tenure tracks in universities are filled to a significant degree with appointees from the expansion era of the 1960's who will not reach the customary retirement age until the 1990's.

It seems highly likely that there will be a serious slowdown, in some cases a virtual freeze, in the hiring of new faculty. Yet, most observers believe that a regular infusion of young scientists is a necessary condition for a healthy and vigorous academic scientific enterprise. I believe there are a number of faculty who would like to pursue a second career, possibly on a part-time basis, away from the institutions

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9/ Teachers Insurance and Annuity Association, The Participant, (New York, N.Y. 10017), January 1976.

with which they are presently affiliated but are inhibited from doing so because of the loss of some of their normal retirement benefits. A significant flow of such faculty into new careers in public or private service--assuming, of course that such positions are available--plus the creation of attractive opportunities for voluntary early retirement could open up a large number of academic positions for young scientists.

In my view, any plan for mid-career change or early retirement should be voluntary--stated otherwise, mutually agreeable to both the university and the individual involved. To be most effective, the plan should enable faculty to make a mid-career change between their mid-thirties to mid-fifties and to choose early retirement in their late fifties and early sixties. The Foundation recently requested proposals for a survey of institutional practices and an assessment of possible incentives and options relating to voluntary mid-career changes and early retirement for university and college faculty in the sciences. The study findings which should be available in late summer, will be widely distributed to give the situation a public airing. The Foundation would like to be able to offer to the academic community a set of feasible policy options which can serve as foci of discussion and action.

Other options are also under discussion. It has been suggested that there be a program to increase the amount of time an outstanding scientist could devote to research by reducing his or her teaching load. This

program is referred to as the Senior Research Scientist Grant Program.

My proposal in this regard is tentative and has not been formally presented to either the executive branch or the Congress. The features of the proposed program have not been worked out in detail, but the major ideas are as follows:

The type of person who could be considered for such a Senior Research Scientist Grant would be one who had a long career of productive research, who was in his or her early to mid-fifties in age, and who was still vigorous, creative and productive. By providing approximately half-time salary support, the grant would enable the person to devote full-time to research during most of his or her remaining years at the institution.

In the selection process, the following criteria would be considered:

- Recognition of accomplishment of senior scientist applicant and outstanding peer evaluation;
- Quality of the applicant's research proposal;
- Existence of age distribution problem in the applicant's department and scientific discipline;
- Quality of applicant's department in relation to all other departments in the field;
- Relation of proposed work to national need (strategic advances in the discipline and/or promise of application in area of national need).

Since the grantee's teaching effort would have to be assumed by another faculty member, a condition of the grant would be that the university use the released salary funds to hire a young faculty member in the same department to assist with the teaching load. Thus, this scheme would

yield additional benefits in that it would aid in the infusion of young faculty into the teaching body and it also would help to decouple research from undergraduate enrollment.

If such a program were tried as a pilot effort, the initial awards might be for up to $25,000 a year for a three year period with the possibility of a one-time renewal for an additional three years. At this point, this proposal is just one of several intriguing possibilities.

It seems clear that some of the trends in faculty positions are not encouraging and may in fact be disastrous in terms of their impact on universities and in turn on U.S. science. In all candor it should be recognized that new Federal initiatives aimed at solving this problem may be limited. Budgetary constraints are real and are not likely to be eased in the near future. Those in universities and colleges, particularly institutions with large research programs, bear great responsibility for developing local initiatives aimed at creating new junior faculty positions. I believe that we all agree to the importance of this task.