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ABSTRACT

Declining opportunities for young researchers at universities and proposals to improve the situation are discussed. Concerns related to opportunities for young researchers include: (1) the leveling-off of student enrollments at universities; (2) the fact that tenure limits faculty turnover; (3) possible effects on research if the age distribution of investigators shifts substantially; (4) the potential effect on the eventual quality of university faculty of limited opportunities; (5) the possibility of insufficient employment opportunities for recent Ph.D.s; (6) access to research funds for young investigators; and (7) the declining proportion of young investigators compared to older investigators. Alternative methods to maintain or improve the nation's research and teaching efforts through greater use of young investigators include: a Young Investigators Postdoctoral Program; a Research Assistant Professorship Program; Research Initiation Grants; and Institutional Support Program. For each proposed program, assumptions, expected outcomes, and strengths and weaknesses are discussed. Indirect approaches to the problem include early retirement, leaves of absence, and part-time employment. Data collected from universities by the National Science Foundation form the basis for the analysis. (SW)

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YOUNG INVESTIGATORS:

CONCERNS, OPTIONS, AND OPPORTUNITIES

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ABSTRACT

This paper addresses declining opportunities for young faculty primarily due to reductions or leveling of enrollments coupled with low faculty turnover. Recently, active interest in young investigators or faculty has been expressed within the academic, science, and government communities. The objective of several alternatives discussed is to maintain or improve the nation's research efforts through greater utilization of young investigators. A concomitant feature of this objective is increased employment opportunities, mainly in academia, for young Ph.D.'s. Assumptions related to productivity of young researchers, their propensity to obtain research funds, and various forms of support are reviewed. Data collected from universities by the National Science Foundation formed the basis for the analysis.

Concerns*

There has been increasing interest in the adequacy of opportunities for young researchers[1] at universities. A number of concerns are related to this interest. One is that student enrollments at universities have leveled off. A major reason for this change is the reduction in the growth rate of college-age persons over the past ten years and the projected decline in the coming one or two decades. Table 1 clearly indicates this decline to 1992 and also provides projections of student enrollments which are expected to remain fairly stable. Even so, it is anticipated that fluctuations in enrollments will vary significantly between universities. It is likely that the more prestigious universities will have greater control over the size of their enrollments and, consequently, faculty. A second concern is that tenure limits faculty turnover. These two concerns combine to limit employment openings for recent Ph.D.'s.

A third concern is the possible effect on research if the age distribution of investigators shifts substantially. It is not that young investigators are necessarily more productive, in terms of quantity or quality of research, but that they are at least as fruitful and provide a needed input, just as mature scientists provide a necessary element. Studies published in the last year or so by Stephen Cole[2] and Nancy Stein[3] support the position that there is no significant correlation between research quantity or quality and age.

TABLE 1

Projected Trends in U.S. Population 18-21 Years of Age, 1977-92, and Full-Time-Equivalent Enrollments in all Institutions of Higher Education, 1977-87

	U.S. Population, 18-21 Years of Age		Full-Time-Equivalent Enrollments	
	Number (000's)	Percent Change Since 1977	Number (000's)	Percent Change Since 1977
1977	16,957	---	8,604	---
1978	17,090	0.8	8,741	1.6
1979	17,137	1.1	8,882	3.2
1980	17,097	0.8	9,021	4.8
1981	17,000	0.3	9,096	5.7
1982	16,856	- 0.6	9,127	6.1
1983	16,482	- 2.8	9,121	6.0
1984	15,976	- 5.8	9,084	5.6
1985	15,431	- 9.0	9,033	5.0
1986	14,864	-12.3	8,975	4.3
1987	14,515	-14.4		
1988	14,465	-14.7		
1989	14,594	-13.9		
1990	14,519	-14.4		
1991	14,189	-16.3		
1992	13,702	-19.2		

Source: U.S. Bureau of the Census, National Center for Educational Statistics, Projections of Education Statistics to 1986-87, Table 8, p. 26.

A fourth concern is the potential effect on the eventual quality of university faculty. On the one hand, the limited opportunities may turn away many capable researchers and reduce the number of young faculty that can be tested or reviewed prior to the award of tenure. On the other hand, universities may take the opportunity to lower the proportion[4] of their young faculty who receive tenure and consequently improve the quality of their permanent staff and also lower the faculty age distribution in the process.[5] Of course, a low proportion receiving tenure may discourage young investigators from ever seeking academic employment.

A fifth concern is that there are or will be insufficient employment opportunities for recent Ph.D.'s. This concern, however, is reduced by the following: 1) academic employment of full-time scientists, including natural and social scientists, and engineers (S&E's) has increased 3% per year for the past eight years; 2) between 1973 and 1977 Ph.D. employment in educational institutions increased by 26% compared to an overall Ph.D. growth of 29%. During this same time the percentage of Ph.D.'s employed in educational institutions who reported R&D as their primary work activity increased; 3) overall unemployment of doctoral S&E's remains a very low 1.2% (for 1977); and 4) employment of Ph.D.'s in industry has increased -- partially because industrial technology has become more complex and partially as a result of the greater supply of Ph.D.'s.

A sixth concern is that the future will be significantly different from the present. While there is no evidence that the trend of proportionately fewer young investigators will stop in the near future, insufficient research has been published concerning projected levels of young investigators at universities to provide a strong basis for decisions.[6] However, since the concern is with utilization, rather than supply, projections are less essential and sequential decision-making is appropriate. Specifically, a small program could be initiated and then expanded or dropped, according to the need for such a program.

A seventh concern is access to research funds for young investigators. The basic question is, "Do recent investigators submit research proposals and receive support in proportion to their numbers?" The answer is that in the fields of science and engineering they actually submit slightly more proposals per person and experience approximately the same success rates per proposal as their more experienced colleagues.[7]

An eighth and final concern is that the proportion of recent investigators is declining. In fact, the faculty in most disciplines has an increasingly higher proportion of older members. This is, at least in part, the result of the unusually young faculty composition in the 1960's due to rapid enrollment growth in the 50's and 60's. An important point to note in this regard is that there is no standard --

a proportion of young investigators that is reasonably determined -- that can be employed for comparison purposes. However, there may be a concensus that the proportion of young investigators should not drop below 25-30%. The latter figure is based on a National Science Foundation funded 1978 survey of science and engineering department chairmen. Their opinions while varying slightly coalesced around 30%. Table 2 presents the results by broad fields of a survey funded by the National Science Foundation and conducted by the American Council on Education survey. Biochemistry, botany, chemistry and physics all have proportions substantially under 20%. By contrast, in 1968 a similar survey concluded that for all fields combined 42% were recent faculty. The declining proportions coupled with uneven distribution by field is the crux of the concerns with regard to recent doctoral researchers.

In an effort to address these concerns several options could be considered. The following section briefly discusses four direct options and concludes with reference to indirect approaches.

Options

The central objective of the various alternatives discussed is to maintain or improve the Nation's research and teaching efforts through greater utilization of young investigators. A concomitant feature of this objective is increased employment opportunities, mainly in academia, for young Ph.D.'s. However, employment or training per se are not the objectives of the programs.

Table 2

Full-Time Doctoral Faculty And Recent Doctoral Faculty In Selected Doctoral-Level Science/Engineering Departments: 1978

Field	Number of Depts.	Doctoral Faculty		
		Total	Recent Doctorates	
			Number	Percent
All Selected Departments	1,809	35,962	8,652	24
Biochemistry	129	1,746	294	17
Biology	134	3,132	724	23
Botany	50	842	139	17
Chemical Engineering	96	994	208	21
Chemistry	183	3,994	690	17
Economics	115	2,468	845	34
Electrical Engineering	113	2,355	479	20
Geology	97	1,319	305	23
Mathematics	151	4,845	1,298	27
Microbiology	122	1,385	328	24
Mining & Mineral Engineering	11	108	25	24
Physics	156	3,781	488	13
Physiology	104	1,505	405	27
Psychology	174	4,344	1,382	32
Sociology	121	2,140	775	36
Zoology	47	998	259	26

Note: Because independent weighting procedures were used for each field, detail may not add to total. Percentages are based on the true proportions of the weighted numerical values.

Source: American Council on Education.

Direct Options

1. Young Investigators Postdoctoral (YIP) Program. Mechanism: Two or three-year, non-renewable, portable awards could be created to provide stipends and funds for research materials and supplies. An institutional commitment to provide access to research facilities would be required. The fellows could accept a job/appointment without losing the full stipend.

Assumptions: The YIP program would be the mechanism of choice, granted the following assumptions:

(1) The added prestige and the research experience gained by the postdoctoral fellows would make them more attractive as candidates for academic or nonacademic research positions, even if they expect greater starting salaries than the new doctorates with whom they will have to compete; (2) the selection by the fellows of their research topics, mentors, and institutions would optimize their contribution to research and their attractiveness to future employers; and (3) the institutions would be willing to underwrite any major costs associated with use of research facilities by these postdoctoral fellows.

Expected Outcomes: The mechanism would be expected to have the following outcomes: (1) increased research output in fields selected by fellows and specified by the program; (2) geographical and institutional concentration of Federally-supported postdoctoral fellows may increase; and (3) the competition for available academic positions in research-intensive universities may be shifted to favor these fellowship recipients over other new doctorates.

Strengths and Weaknesses: The strengths of the YIP approach would be: (1) no need for the postdoctoral fellows to seek additional research support until they have had time to prove themselves; (2) supported administrative and indirect costs would be minimal; and (3) the post-doctoral fellows could devote all their time to research. The weaknesses of the YIP as proposed would be: (1) the institutions might incur substantial additional costs in support for these fellows; (2) the application pressure would more likely reflect the current employment situation for new doctorates in each field than the needs derived from research developments; (3) greater concentration in a few institutions/regions without some rules for institutional and geographic distribution; and (4) no incentive would be provided to open up a permanent position after the fellowship is completed or to appoint the post-doc to a position that is opened up.

2. Research Assistant Professorship (RAP) Program. Mechanism: A multi-year grant could be awarded to universities to support young scientists, mainly for research, although some teaching would be permitted. One opportunity to renew the grant would be available, based on the scientific merit of the individual's research. The university must demonstrate that the new appointment would not be a replacement for a comparable existing position, that the facilities and colleagues would benefit both the appointee and the scientific field, and that it has a long-term plan for ameliorating the age distribution

of its faculty. Geographic distribution would be considered in making awards. The individual would have regular academic status and promotion opportunities.

Assumptions: The main premise is that the viability of basic research in the long run depends on a steady inflow of qualified young scientists into academic positions (as opposed to providing, say, some additional incentives for the young to conduct basic research in industry). It is also assumed that young scientists require a reasonably stable and supportive institutional base for their research to flourish.

Expected Outcomes: (1) The quality of young faculty research would depend much on the way the departmental colleagues choose the young scientists. But regular selection practices and the renewal opportunity should provide an incentive to the university to obtain exceptionally competent and research oriented individuals; (2) the total amount of research resources available to the field would almost by definition not change, but there could be some reallocation between established researchers and young researchers. Older faculty could retire or leave earlier, if the incentive to plan for improved age distribution is adequate. Thus, total young faculty would increase somewhat and there would be more young faculty applying eventually for regular research grants; (3) the outcomes would be significantly affected by the emphasized criteria. If the emphasis is on the quality of the contribution that the selected department can make to the field,

the effect would probably be to increase the concentration of funds. If the emphasis is on the potential contribution of the individual to the institution and the department, the effects would be otherwise.

Strengths and Weaknesses: The strengths of the RAP approach would be: (1) The renewal option would provide an incentive to the university to choose strong candidates and provide an incentive to the researcher to conduct high quality research; and (2) provide an incentive for universities to deal with the "aging faculty problem."

The weakness in the RAP approach is that more review criteria would be involved than for most other grants or for the alternatives considered. Agreement on the weights to attach to each criterion might be difficult to achieve.

3. Research Initiation Grants (RIG). Mechanism: This one-time non-renewable grant would provide salary support for some released research time during one academic year and two summers, along with the usual research grant provisions including indirect costs. Only recent Ph.D.'s (probably 1-3 years removed) who essentially are already faculty members would be eligible. Some portion of the research may be conducted at another institution.

Assumptions: Young investigators eligible to apply for regular research grants cannot adequately compete against more established applicants. (However, this has been shown to be unlikely.)

Expected Outcomes: (1) The research opportunities and the amount of research done by young faculty members would increase. The quality of

the research conducted by young investigators would probably also increase; (2) the employment opportunities and the rate of retention of young faculty in academia might be ameliorated slightly, but probably no measurable impact would occur because the total research budget would remain the same. Of relevance here might be university perceptions of the opportunities that recipients of the one-time RIG have in obtaining subsequent regular research grants; (3) as with regular research grants, geographic distribution would be considered in making awards. Whether such a program would increase or decrease concentration of funds beyond what would be otherwise is difficult to say. The effects may vary over time and by scientific field, depending on the changes in the proportions of younger and older faculty employed in academic institutions.

Strengths and Weaknesses: The main strength of the RIG approach is that as compared with the proposed postdoctoral research program which would permit only limited reimbursement, this program may permit relevant research expenses to be met. In this sense the program would allow more opportunities to young investigators and, of course, greater support to universities.

The main weakness of the RIG approach is that no additional young faculty are hired.

4. Institutional Support Program (ISP). Mechanism: It would provide support to universities and separately organized research centers or institutes for use in establishing additional positions for young

investigators. The grantee institution could use the support to offer a combination of new staff positions, postdoctoral appointments, and access to research facilities. The latter feature would enable young investigators at other institutions to use special research facilities without having to secure research support in their own right.

Assumptions: The institutional support mechanism would be particularly viable if the following assumptions hold: (1) there would be need for a mix of new permanent positions and new temporary postdoctoral positions at many institutions; (2) the strength of the research effort would be maximized by allocation of resources among competing institutions and fields of science and through local selection of young investigators; and (3) the institutions could not undertake the support of these new positions and additional use of their research facilities without additional support.

Expected Outcomes: The institutional support mechanism would be expected to have the following outcomes: (1) increased research output in fields and at institutions selected, and (2) possibly greater geographic distribution of supported researchers.

Strengths and Weaknesses: The main strength of the institutional approach for granting institutions would be to shift the administrative burden from processing and monitoring many small awards to a smaller number of relatively large dollar items. The weaknesses of the institutional approach would be (1) the creation of a set of institutions that may press for continuing support and thereby limit future

initiatives; and (2) only a fraction of the total funds would actually go to the support of young investigators, much of the rest of the funds would go for senior staff and indirect costs.

Indirect Approaches

Several indirect approaches have received consideration. However, they have not reached the level of the development of the previous alternatives. Therefore, they will be presented in a condensed format.

One of the mechanisms is early retirement through a program to assist senior faculty members to enter a second career. Mid-career shifts and retraining of older faculty members for various motives would, in turn, provide greater employment opportunities for young Ph.D.'s. These faculty members would probably embark on a second career well before retirement age. However, there are obstacles to such a shift. Most faculty retirement plans do not allow for such an early retirement by its members and, to keep their retirement plans active, contributions to the plan must continue until actual retirement age is reached. However, it may be possible to introduce an incentive program for faculty members who are willing to start a second career by contributing a portion of the funds necessary to maintain a professor's retirement plan. There could be some problems instituting such a program to insure equal opportunities for all faculty members.

Another indirect alternative would be to utilize the number of opportunities for professors on leaves of absence, to try new kinds of work with different organizations. Although the programs which sponsor

such activities are not primarily concerned with career change, a substantial minority of these professors do decide to remain with the new organization outside the academic world. Conducting a study related to career changes by tenured faculty members, Abt Associates found the main obstacle to the encouragement of this program lies in the minimal control over professors chosen for such grants. It is likely that the selection criteria employed actually would not benefit most colleges and universities. These programs tend to select the more productive faculty members, whereas academic institutions would prefer to encourage career change among the less productive faculty members.

Finally, part-time employment is a flexible alternative that could be used in conjunction with a number of the approaches mentioned. Part-time faculty appointments with joint positions in industry could be considered. Part-time employment could also be a mechanism that would partially resolve the economic problems of the individual, and the loss of key skills by the institution, related to early retirement.

Opportunities

The options in the preceding section merit attention while at the same time other alternatives outside academia can be explored.

The substantial supply of new Ph.D.'s in conjunction with the relative decline in the academic job market can be viewed as a problem or an opportunity. As increasing percentages of doctorates take non-traditional jobs, the change can be perceived as individual under-utilization or as position enrichment.

There is no a priori reason that Ph.D.'s should mainly be employed in academia. As both the student and the university modify their expectations and perspectives there can be greater understanding of, and preparation for, types of employment that have been comparatively ignored. This flexibility will provide opportunities for curriculum expansion and modification, for greater departmental liaison with a wide variety of prospective employers, for a diverse research program that would entail both basic and applied research, and for an expansion of joint efforts with industry and government.

In conclusion, the perspective adopted emanating from the supply and utilization of new doctorates is related to pessimism or optimism. Are there mainly problems or opportunities? Is the glass half empty or half full?

FOOTNOTES

Acknowledgment is given to information and assistance provided by Dr. Charles Dickens and others in the Manpower Studies Section at the National Science Foundation.

1 Doctorates who have received their degree within the past seven years.

2 Cole, Stephen. "Age and Scientific Performance." American Journal of Sociology. LXXXIV, 4, 1979.

3 Stein, Nancy. "Age and Achievement in Mathematics: A Case Study in the Sociology of Science." Social Studies of Science. VIII, 1, 1978.

4 Only several years ago a 50% tenure ratio (1 of 2 young investigators would receive tenure) was considered harsh, but today it is increasingly accepted.

5 If no young investigators are offered tenure they could in turn be replaced with younger investigators.

6 The National Science Foundation will publish, later this year, their projections of Ph.D. supply and utilization, which will be extremely useful.

7 Atelsek, Frank J. and Irene L. Gomberg. Young Doctoral Faculty in Science and Engineering: Trends in Composition and Research Activity. American Council on Education, February, 1979.