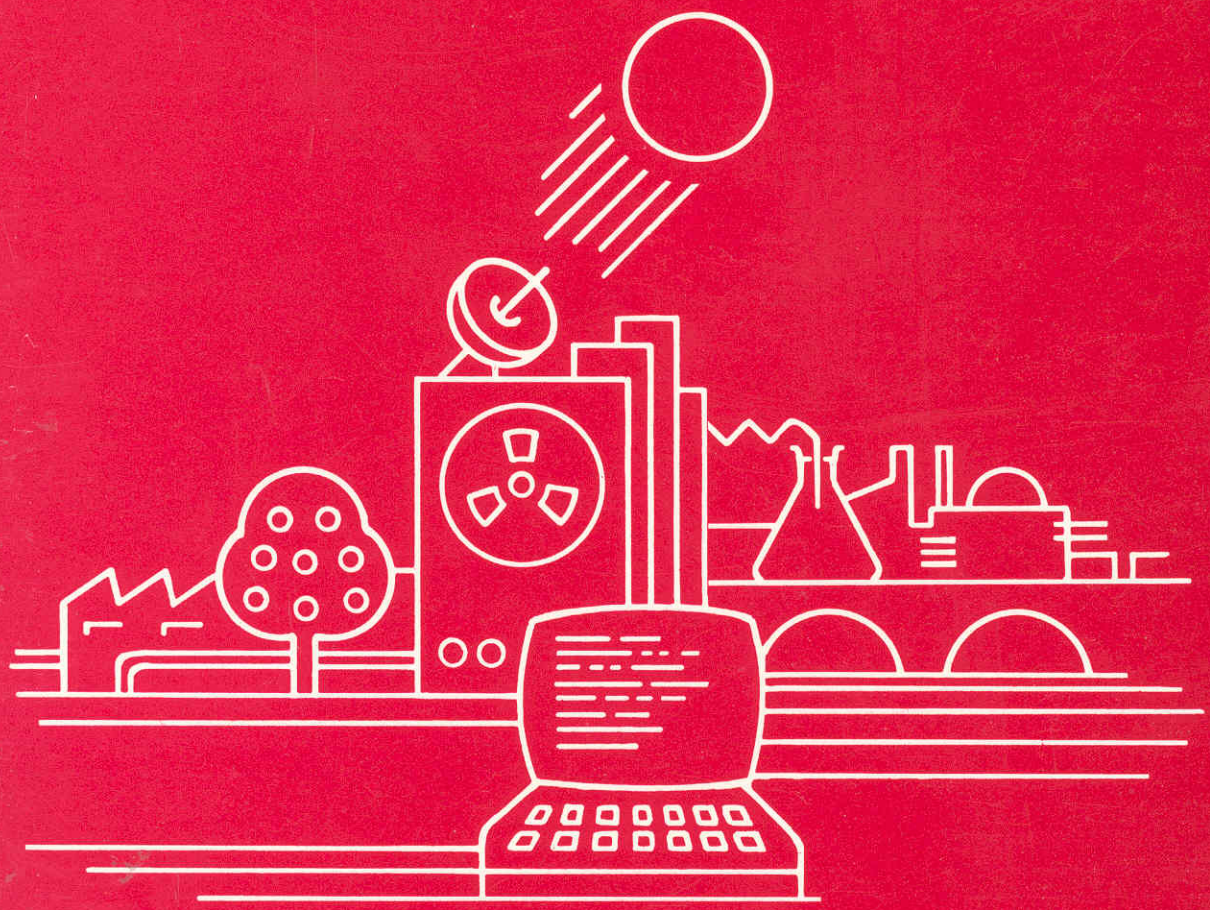
FURTHER INVESTIGATIONS IN

THE EVALUATION OF SCIENTIFIC ACVITITY

Edited by **Bluma C. Peritz**



Studies in Science Policy ⑤

Technion - Israel Institute of Technology
The S. Neaman Institute for Advanced Studies
in Science and Technology

FURTHER INVESTIGATIONS IN THE EVALUATION OF SCIENTIFIC ACTIVITY

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May 1993

Preface

In May 1992 an International Information Conference took place in Tel-Aviv, within the framework of "Info 92," the Israeli Information Week organized by Teldan. During the conference a one-day session on "The Evaluation of Scientific Activity: Methods and Tools" was organized by the S. Neaman Institute for Advanced Studies in Science and Technology. The present publication is an outcome of that session.

The session included five lectures and an open discussion forum. Robert Kimberley of the European Branch of ISI lectured on *How does ISI Support and Strengthen the Study of Scientific Activity*, Meir Zadok, Director of the Israel Academy of Sciences spoke on *The Use of Indicators in the Formulation of Science Policy*, Bluma Peritz presented a paper on *The use of Meta- analysis as a Method in Citation Analysis;* Shlomo Herskovic of the Council of Higher Education presented an extensive *Evaluation of a Peer Review System - the Yigal Allon Fellowship Program*; and finally, Edna Granit talked about *Scientific Cooperation between Israel, German and French Scientists in Medicine and the Life Sciences.*

Although all the presentations elicited wide interest from the audience, it was decided to include in this publication only papers which present original research contributions. In consequence, only the last two papers are published here. However, the authors agreed to expand their original lectures so that we are able to put before the reader two fairly extensive and

detailed studies.

The evaluation carried out by Herskovic deals with one of Israel's major avenues of entry into academia: the Allon fellowships for outstanding young researchers. He was able to show that the recipients of that fellowship were much more productive than the other candidates who were subsequently admitted to faculty positions. Both the scientific output of the fellow and the impact of their work - as measured by citation counts - were substantially higher than those of the other candidates. The author is careful to point out that this may be due, to some extent, to the enhanced prestige of the Allon fellows, which in turn, may enable them to obtain more readily the resources needed - for research; nevertheless, the wealth of hard data presented in the paper tends to make such an interpretation unlikely.

The study of Granit and Peritz deals with one of the most important aspects of research activity: the cooperation between scientists from different countries. The subject of their work was the cooperation between Israeli scientists on the one hand and German or French scientists on the other, in medicine and the life sciences. The main findings were the following: a) cooperation between Israel and German scientists is much more frequent than that between Israel and French scientists; b) the number of cooperative publications in the life sciences was only slightly lower than that in medicine; c) the percentage of cooperative publications originating at the Hebrew University was the highest among Israel academic institutions but

the number of outstanding (most cited publications) was highest for the Weizmann Institute; d) within the life sciences, over 40% of publications are in biochemistry and molecular biology, in medicine, however, no dominant field could be discerned; e) the cooperative research activity in the faculties of medicine often deals with the life sciences and, vice versa, life sciences faculties often carry out medical research. These findings suggest some ideas which could be substantiated by a comparison with Israel-American research and with wholly indigenous Israeli scientific activity.

This publication was possible only through the efforts of several persons and institutions. Thanks are due in particular to Professor D. Weihs for his support and to the S. Neaman Institute which published it in its series on "Studies in Science Policy".

We also acknowledge grateful the cooperation with Mr. A. Sofrin and Teldan, organizers of Info-92, who included this session in their conference. Last but not least, we wish to acknowledge the enthusiastic and devoted help of D. Kohn of the S. Neaman Institute without whom this publication would not have become a reality.

Dr. Bluma C. Peritz
Director, School of Library, Archive
and Information Studies
The Hebrew University, Jerusalem

COOPERATION BETWEEN ISRAELI, GERMAN AND FRENCH SCIENTISTS IN THE LIFE SCIENCES AND MEDICINE DURING THE YEARS 1980-1989: A COMPARATIVE BIBLIOMETRIC STUDY*

Edna Granit,
Henrietta Szold Institute, Jerusalem, Israel

Bluma C. Peritz
School of Library, Archive and Information Studies,
Hebrew University, Jerusalem

INTRODUCTION

Basic research is one of the focuses of university activity. In Western society, this activity is funded mostly by governmental bodies because it benefits society (Jacobi, et al., 1988).

According to the report of the Israeli National Science Academy, since the beginning of the 1970s there has been a decrease in governmental support for basic research conducted at institutions of higher education and research institutions.

The amount of money allocated in the national budget for higher education is declining. This poses a threat to basic scientific research (Jacobi, et al., 1988).

Czapski, et al. (1989) have suggested that this deterioration of research conditions, including reduction of the allocations, probably contributes to the gradual transfer of scientific activity to places outside the borders of the

* This work was partly supported by the S. Neaman Institute for Advanced Studies in Science and Technology of the Technion - Israel Institute of Technology. Special thanks to Mr. David Kohn for his valuable help.

country. Abroad, scientists can find more funding, more comfortable research conditions, and more modern equipment.

The present study was partially motivated by the suggestion of this phenomenon. This is a comparative bibliometric survey of research cooperation between Israeli scientists and scientists abroad. The goals of the research were: 1) to examine the scientific cooperation among Israeli researchers and researchers in two EEC countries, Germany and France, and 2) to compare the cooperation between these two groups of researchers and to examine the motives for this cooperation in the fields of life science and medicine during the years 1980-1989.

Purposes of the Study

There are four aspects to the purposes of this study:

1) The volume and nature of scientific output:
   a. to examine the range of research cooperation,
   b. to examine the main fields of cooperation,
   c. to examine the degree of research cooperation between specific Israeli research institutes and their French and German counterparts,
   d. to examine whether there was a change in the degree of cooperation during the course of the 1980's and, if so, of what sort.

2) The "quality" of the cooperative research:
   a) to examine the citation frequency of the cooperating researchers, which provides an indirect indication of the quality of the research,
   b) to locate the research groups and to identify the outstanding researchers in their fields.

3) The motives for cooperation:
   to identify the motives for scientific cooperation among the identified researchers.

4) A comparison of the degree of cooperation between Israel and Germany with that of Israel and France in regard to the aforementioned issues.

RESEARCH METHODOLOGY

The Database

The database for this research was that portion of the computerized database of the *Institute for Scientific Information*, (I.S.I.) in Philadelphia, which is held by the S. Neaman Institute for Advanced Studies in Science and Technology of the Technion - Israel Institute of Technology. The S. Neaman Institute database includes all citations and bibliographic data of all publications in which at least one of the authors gave an Israeli address.

The Research Instruments

1. Structured bibliometric questionnaires

2. Structured self-reporting questionnaires addressed to the outstanding researchers.

The Research Population

The base for the research consisted of 76,000 records of publications published during the years 1980-1989. From this database were drawn two groups: 1. Israel-Germany, which included all the records which had at least one address in Israel and one address in Germany. This file consisted of 644 entries, and 2. Israel-France, which included all the records which had at least one address in Israel and one address in France. This file consisted of 320 entries. From the combined files we defined two populations:

1. the publication population which included 964 publications, and;
2. the population of outstanding publications from among the 964 publications, which was defined as including all publications which were cited twenty-three times or more.

This number was selected because it represented the upper first percentile of the total number of citations. This population included 96 records, including 71 of Israeli-German cooperation and 25 of Israeli-French cooperation. Unfortunately, in the definition of outstanding publications we could not adjust for when the work was published: more recent publications have less opportunity to be cited. However an analysis of the number of outstanding publications appearing each year suggested no significant differences.

For the purposes of this study the population of outstanding publications also provided a definition of the outstanding scientist: a researcher whose work was cited 23 times or more.

Results

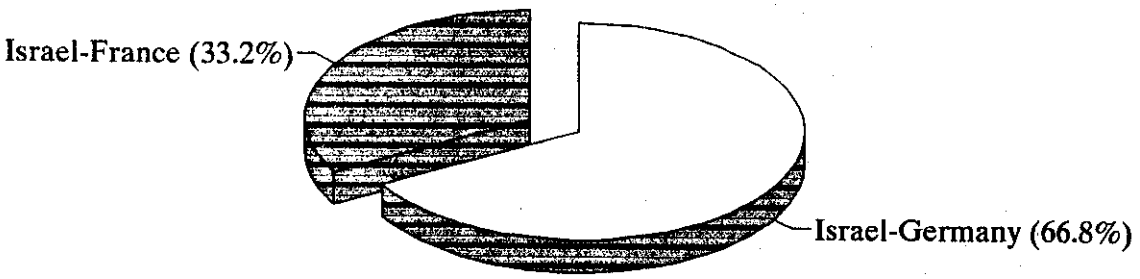
The principal findings of the study are summarized in this article.

The Comparative Frequency of the Cooperation by Countries:
The scientific cooperation between Israel and Germany was more frequent than the scientific cooperation between Israel and France. 66.8% of the research was conducted in cooperation between Israel and Germany and 32.2% of the research was conducted in cooperation between Israel and France. The incidence of cooperation between Israel and Germany is 50% higher than between Israel and France (Table 1).

The Trend in Fields of the Research:
Each publication was categorized according to the categories of the Institute for Scientific Information (I.S.I.). The I.S.I. categorizes a publication according to the name of the journal in which the publication appeared, and not according to the publication itself. This creates a possible bias because, for example, an article which dealt with mathematics could appear in a journal of biology and be wrongly categorized as biology. The I.S.I. categories are distributed among the life science and medicine according to the Dewey system of classification.

Table 1

Frequency of Scientific Cooperation Among Israel-Germany-France (%)



A remarkable finding is the fact that of all the fields of research cooperation, biochemistry and molecular biology comprised over 40% of all research in both the Israel-Germany group and the Israel- French group. However, in medicine no similar dominant field appears (Table 2 and Table 3). This finding raised additional questions, including: Why was so much shared interest in the fields of biochemistry and molecular biology and, is it typical for joint endeavors in these fields or is it reflective of the character of the research community in Israel? The present research does not clarify the answers to these questions. Therefore, we have to stress two limitations to the findings:

1. we do not know if this situation is common in the Israeli research community, and;
2. we do not know if this situation is typical for joint endeavors between Israeli and United States scientists.

Comparison of the Nature of Research and Cooperation at the Research Institutes Within Israel

In this study we defined three kinds of research institutes:
1. universities
2. research institutes
3. other institutes.

In comparing the results between the types of research institutes, we saw that the Hebrew University was the institute with the most publications (Table 4). However, when using this study's definition of outstanding publications, we see a surprising result. 18% of outstanding publications were published at the Weizmann Institute; 15% of outstanding publications were published by the Tel Aviv University; 8.4% by Technion and 7.5% by Hebrew University (Table 5). From these results, we can conclude that, while at the Hebrew University there is frequent cooperation with German and French institutes, the research published is cited less often by other researchers.

Table 2

Frequency of the Scientific Output by Fields in the Life Sciences

Fields	N	% of total Publicatons	% of total Publications in Life Sciences
Biochemistry & Molecular Biology	225	18.7	41.4
Biophysics	75	6.3	13.8
Microbiology	41	3.4	7.6
Genetics & Heredity	38	3.2	7.0
Botany	36	3.0	6.6
Physiology	29	2.4	5.3
Parasitology	19	1.6	3.5
Biology	15	1.3	2.8
Mycology	14	1.1	2.6
Zoology	13	1.1	2.4
Others *	38	3.2	7.0
Totals	543	45.3	100.0

* Others included the following fields:

Marine & Freshwater Biology, Toxicology, Entomolgy, Biology Miscellaneous, Math. Methods, Biology & Medicine, Nutrition & Dietetics, Biotechnology & Applied Microbiology, Fisheries.

Table 3

Frequency of Scientific Output by Fields in Medicine

Fields	N	% of total Publicatons	% of total Publications in Medicine
Immunology	95	7.9	14.5
Cytology & Histology	67	5.6	10.2
Medicine General & Internal	57	4.8	8.7
Hematology	49	4.0	7.5
Oncology	43	3.6	6.6
Neurosciences	42	3.5	6.4
Pharmacology & Pharmacy	38	3.1	5.8
Medicine Research & Experimental	33	2.8	5.0
Endoctrinology & Metabolism	31	2.6	4.7
Cardiovascular System	30	2.5	4.6
Virology	29	2.4	4.4
Dermatology & Veneral Diseases	18	1.5	2.7
Geriatrics & Gerontology	14	1.2	2.1
Orthopedics	13	1.1	2.0
Others *	97	8.1	14.8
Totals	656	54.7	100.0

* Others included the following fields:

Embryology, Pathology, Urology & Nephrology, Pediatrics, Anatomy & Morphology, Obstetrics & Gynecology, Psychiatry, Dentistry & Odontology, Anesthesiology, Ophthalmology, Surgery, Gastroenterology, Rheumatology, Tropical Medicine, Radiology & Nuclear Medicine, Allergy, Otorhinolaryngology, Public Health, Veterinary Medicine.

Table 4

Frequency of Scientific Cooperation by Research Institutes in Israel (%)

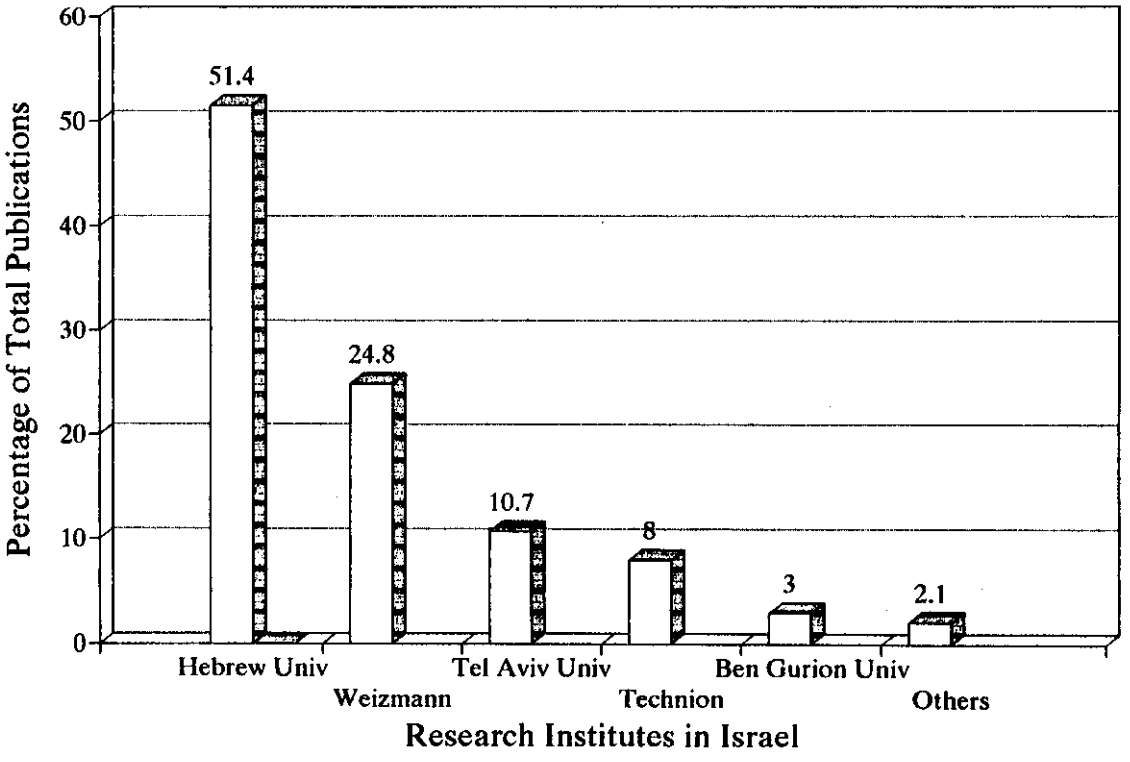
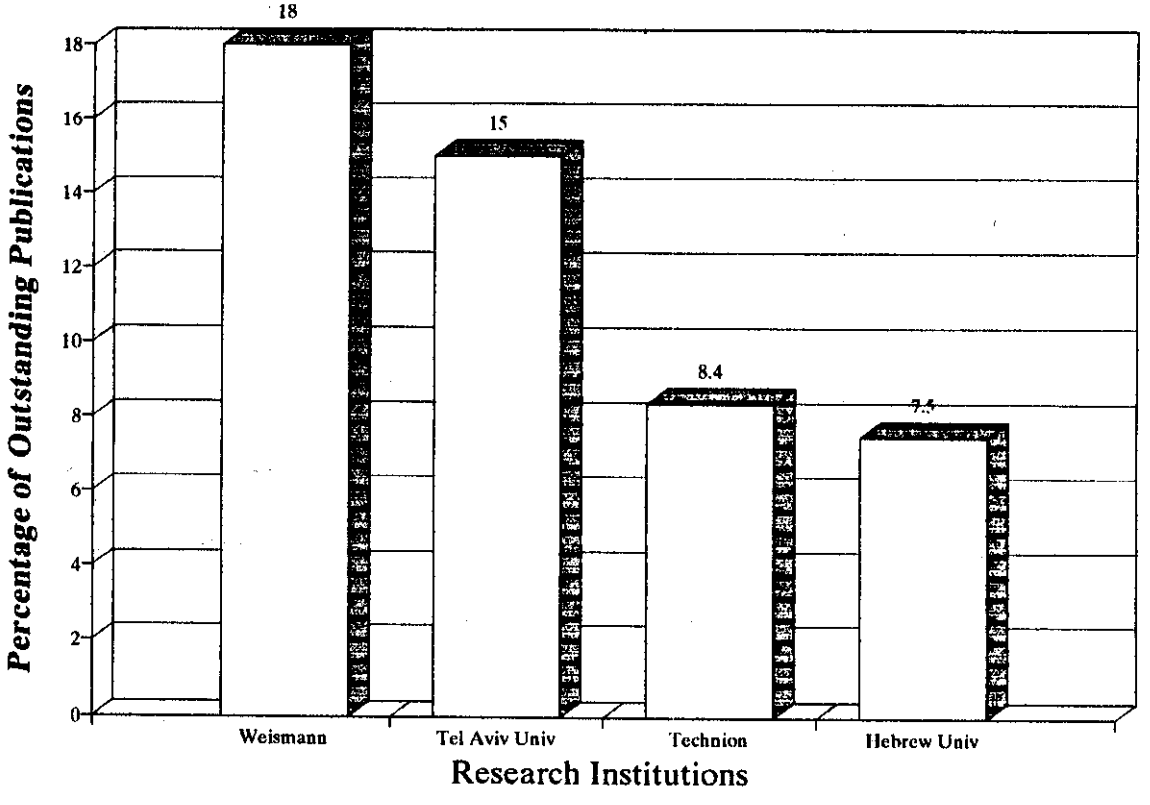


Table 5

Percentage of Outstanding Publications by Institution



In our research we wanted to determine whether medical faculties carried out life science research, and, vice-versa, if the faculties of life science and the research institutes were involved in medical research. The research showed that both fields had significant involvement in both categories of research (Table 6). From this table, we can see that from the total population of publications, 10% more were in the field of medicine than in life sciences. (Approximately 55% were in the medical field; 45% were in the life science fields.)

It is evident also that medical research is carried out by life science faculties as well as within medical faculties (15% of the medical research is done in the life science faculties).

The Outstanding Scientists

Mother tongue and country of origin

It is known from the literature that language is one of variables which influence the cooperation between researchers. In our research, we saw that nearly half of the Israeli scientists cooperating with French researchers were originally from a French-speaking country, or they spoke French as a second language. However, they reported (82.5%) that the fact they knew the language did not influence the decision to cooperate. In contrast, Israeli scientists cooperating with German researchers did not report sharing German as a common language (Table 7).

Financial resources

Approximately 90% of the outstanding publications were funded from outside Israel, and most of the researchers had more than one source of funding. From Table 8, we can see that approximately 50% of the research conducted in Germany and France was funded by sources within the host country.

Table 6

Frequency of Scientific Cooperation by Fields and by Institute (Faculties of Medicine and Life Sciences) (%)

	Fields	
Institute	Medicine	Life Sciences
Faculties of Medicine	29.3	14.9
Faculties of Life Sciences	25.4	30.4
Totals 100	54.7	45.3

Table 7

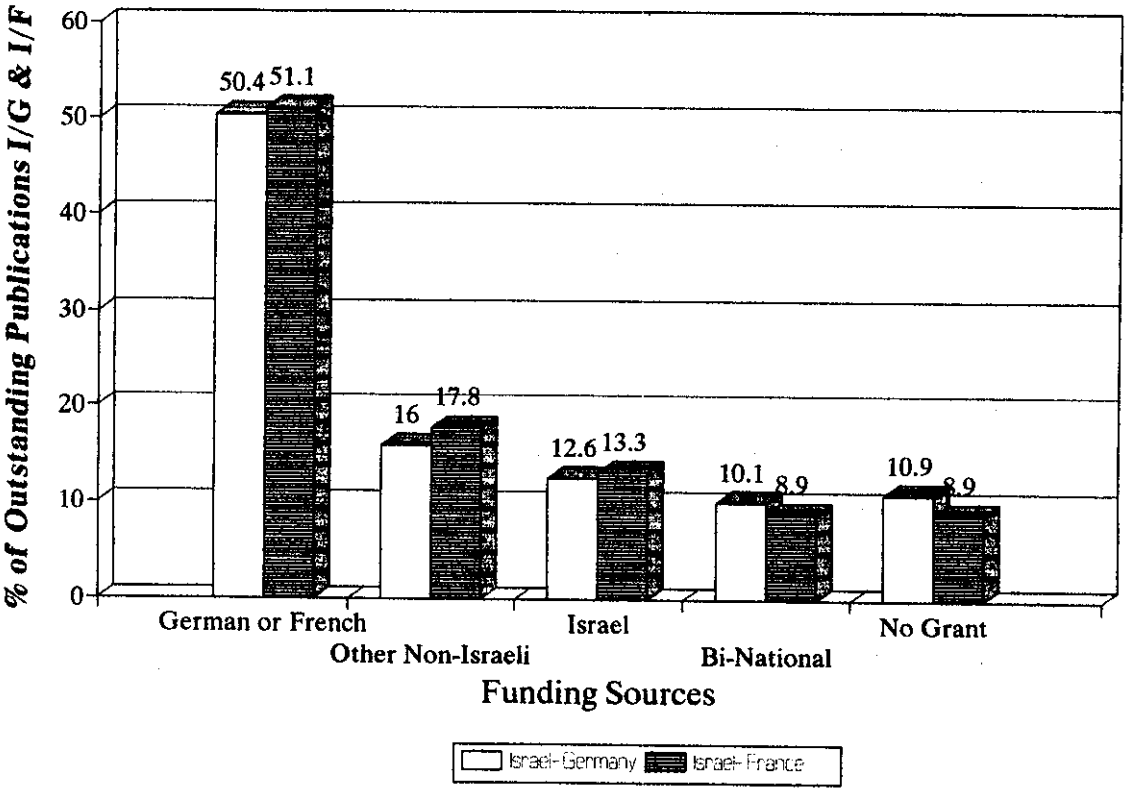
Frequency by Country of Origin and Mother Tongue of the Outstanding Scientists Cooperating with France (%)

	Israel-France
Country of Origin	**N=14 ***
Israel	29
France	29
Morocco & Algeria	14
Germany	14
Other	14
Total	100
Mother Tongue	**N=14**
French	43
Hebrew	36
German	14
Other	7
Total	100

* N= Number of Scientists answering the question

Table 8

Frequency of Outstanding Publications by Funding Sources (%)



Frenkel, et al. (1991) showed in their research that, in the fields of life science, Israeli researchers were more successful in obtaining funding from outside the country than were researchers in other fields. They suggest one explanation of this funding pattern as being the fact that research foundations prefer funding research in the life sciences. Another explanation could be that some Israeli scientists establish their own contact with funding sources outside the country.

What was the main reason reported by the scientists for their cooperation? The leading motive reported by the scientists for cooperation was shared interest in the research questions (38.6%). Other motives included: availability and quality of equipment and laboratories (33.3%); desire to learn new methods and the speciality of the other researcher (17.5%), and finally, the availability of financial resources (10.6%).

Summary

This comparative bibliometric study examined scientific cooperation in the fields of life science and medicine between Israeli scientists and German and French scientists. This is the first study to have surveyed the outstanding scientists in the fields of life science and medicine.

This study presents a picture of the institutes and fields in which scientific cooperation is occurring. We have identified outstanding scientists in the Israeli institutes involved in such cooperation. Finally, we have identified fields in which cooperation most often occurs. In this writer's opinion, one of the most important questions raised by this research is: Is scientific activity being transferred to outside of the country? This is an area for future investigation.

Acknowledgements: The author thanks Dr.Nancy Rains and John Slothower for help in translation.

References

1. Jacobi, G., et al., *The Future of Higher Education in Israel: On the Flour and the Spiret.* Tel Aviv: The Pinhas Sapir Center for Development Tel Aviv University, 1988. Discussion paper series 5-88. 29 p. (In Hebrew).

2. Czapski, G., Frenkel, A., Shoham, A. *Research by Israeli Scientists in Israel and Abroad.* Haifa: The Samuel Neaman Institute for Advanced Studies in Science and Technology - Technion, 1989. 53 p. (In Hebrew).

3. Frenkel, A., Shoham, A., Czapski, G. *Cooperation Betweem Israeli and Foreign Scientists in the Experimental and Engineering Sciences.* Haifa: The Samuel Neaman Institute for Advanced Studies in Science and Technology - Technion, 1991. 59 p. (In Hebrew).

4. Oren, N., Abramsky, O. *Neurosciences in Israel.* Jerusalem: Ministry of Science and Technology, 1989. 301 p.

AN EVALUATION OF A PEER REVIEW SYSTEM - THE YIGAL ALLON FELLOWSHIPS PROGRAM FOR OUTSTANDING YOUNG RESEARCHERS

By **Shlomo Herskovic**

Planning and Budgeting Committee - Israel Council for Higher Education

Introduction

In response to the general austerity that enveloped the universities of many western European countries beginning in the late 1970's, agencies responsible for higher education in some countries developed special programs in order to ensure the continued absorption of outstanding young scientists and scholars into the academic-track faculty ranks of the universities (Kidd).

Under similar circumstances, the Planning and Budgeting Committee (PBC) of the Israeli Council for Higher Education established in 1978 a small-scale experimental peer-review based competitive program of this type, called the "Barecha Fund Fellowships Program", which was initially supported by a donation from this fund. With its initial success, the PBC decided in 1981 to continue the program and enlarge its scope from its own funds, renaming it in honor of the Minister of Education and Culture who was instrumental in establishing the PBC, the late Mr. Yigal Allon.

Acknowledgements: I gratefully acknowledge the assistance and good counsel of A. Pazy, R. Silberberg and the late H.Horn and the comments of S. Shaltiel. Special thanks are due to A. Shoham and A. Lapin of the S. Neaman Institute for Advanced Studies in Science and Technology for their assistance in preparing and analysing the bibliometric data and to J. Yellinek for his assistance in preparing the statistical tabulations. Nonetheless, the author is solely responsible for the contents of this paper.

With time the program grew in scope and stature. Over the years of its operation the program has awarded over 300 three-year fellowships to young researchers in Israeli universities, from among more than one thousand candidates who took part in the competition in a wide variety of fields in the sciences, arts and technology. The vast majority of candidates who were awarded fellowships continue to work in the universities and contribute to the development of Israel's scientific infrastructure. According to our estimates, they represented almost 7% of the senior academic staffs in the universities at the end of the 1980's. The fellowship itself has become a highly coveted award in the eyes of young scientists, the academic community as a whole, and university administrators.

In recent years we have witnessed changes in Israel that will have far-reaching consequences for the academic labor market of the 1990's. In contrast to the virtual freeze on new posts in the 80's, a substantial increase in the number of students is forecast due to the massive immigration from the Soviet Union and the natural growth of the relevant age group for higher education in the existing population. In addition, the generation of researchers who were recruited to the university staffs during the period of rapid growth in the 60's and early 70's are reaching retirement age in growing numbers. As a result, many positions will be added to the higher education system or will become vacant during this decade. This new situation necessitates a reevaluation of the function and operation of the Yigal Allon Fellowships program.

Aims and Method

In this paper we summarize the results of a study we undertook, focusing on the career development and academic and scientific achievements of the candidates who were awarded fellowships (hereinafter: the fellows). The parallel career development and achievements of a similar group of highly select researchers, i.e., candidates submitted by universities who did not win fellowships (hereinafter: the unsuccessful candidates), serve as a control group and basis for comparison. The aim of this paper is threefold:

1. to describe the Allon Fellowship program and its development over time;

2. to examine the extent to which fellows developed academic careers in Israeli universities, as oppposed to unsuccessful candidates;

3. to examine whether or not the academic advancement and scientific achievements of fellows were on average significantly different than those of the unsuccessful candidates, or was the peer-review system set up to evaluate the candidates successful in picking the best candidates.[1]

The study is based on data on the following:

1. Demographic and educational background traits of the candidates. These data were drawn mainlyfrom the Allon Fellowships application forms of the candidates submitted to the PBC. Supplementary data, where necessary, were obtained directly from the institutions where the candidates are employed or from other sources such as the universities' research reports.

2. Information on candidacy for Allon Fellowships and its results, such as the year of candidacy, the institution that submitted the candidacy, the academic unit that was to employ the candidate, whether or not the candidate was successful in the competition for a fellowship, and whether or not the fellowship was actually taken up. These data were taken from the administrative files of the Allon Fellowships retained at the PBC.

3. Information on the academic careers of candidates. This information was obtained from the universities that submitted the candidates and/or employed them. A special questionnaire was prepared by the PBC for this purpose and sent to the rectors of the universities.

4. Information on the scientific output of the candidates and its impact. This information was prepared for us by the S. Neaman Institute for Advanced Studies in Science and Technology at the Technion - Israel Institute of Technology, based on a database of publications of Israeli researchers appearing in the Science Citation Index (SCI). This data base was acquired by the Neaman Institute from the Institute for Scientific Information (ISI) that produces the SCI.

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1 It should be noted already at this stage that these two questions are not necessarily synonymous. A significant positive difference in the academic advancement and scientific achievement of fellows as opposed to non-successful candidates, while highly supportive, does not prove unequivocally the contention that Allon fellows were the candidates with the greatest potential for success as academic scientists.

The paper is divided into five sections. The first section analyzes the main trends in the development, scope and demand for senior academic staff in Israeli universities during the 1980's, which provides the relevant background for understanding the PBC's initiative in establishing the Allon Fellowships program and the development of the program over the years. The second section describes the regulations and procedures of the program and examines the growth and scope of the program over time. In the third section we examine the career development of the candidates submitted up through 1988/89 from their initial employment in an Israeli university to their employment activities at the beginning of the 1990/91 academic year (October 1990). The fourth section examines the academic and scientific achievements of the fellows, compared with those of the unsuccessful candidates, using such criteria as their standing on the academic rank ladder and their scientific output (publications) and its impact (citations). In the final section we discuss the main findings and draw conclusions.

1. Trends in Senior Academic Staffs in the Universities During the 1980's -

During the 60's and the early 70's development in the university system was unprecedented. The children of immigrants who reached Israel immediately following the establishment of the State reached the relevant age groups for higher education and began to enter the universities in increasing numbers. The number of students in the universities increased five-fold during fifteen years - from 10,000 students in 1959/60 to approximately 50,000 students in 1974/75 - an average annual increase of 11.3%. Tel-Aviv University and Bar-Ilan University, which were founded in the 50's, grew to mature size during this period and two new universities opened - Ben-Gurion University of the Negev and the University of Haifa, bringing the total number of Israeli universities to seven, as at present. However, the rate of growth began to slow down considerably in 1974/75 and during the next fifteen years, until 1989/90, the number of students increased by only 18,000 - an average annual increase of only 2.1%.

This abrupt change in the rate of increase of the number of students, together with the cutbacks in public budgets for higher education during the period of stagflation from the mid-1970's and during much of the 80's converged to almost completely stop the increase in senior academic staff (lecturer and above) funded from the normal operating budgets at the universities. Most of the senior academic staff members

in 1978/79 (the first year from which we have a series of reliable and periodical data on the scope of university academic staff) were undoubtedly recruited in the years following 1960. The senior academic staff in this year was relatively young. Table 1 shows that their calculated median age was 43.1, and only 15% were above the age of 55. Until 1983/84 the number of senior academic staff continued to grow and reached approximately 3,800 full-time positions, compared with 3,400 in 1979/80. This number remained more or less stable until 1989/90.

No reliable and consistent data exists in Israel on the number of annual new appointments to academic-track positions in Israeli universities. Based on the trends in total senior academic staff described above, data on attrition rates over the period 1975/76 - 1983/84 in Israeli universities in the fields of the natural sciences and technology (Nvo-Ingbar, 1987) and data on attrition rates of Allon Fellowships candidates, we developed a simplified model for our study in order to obtain a rough estimate of this parameter. According to our estimate, the number of annual new appointments in Israeli universities dropped from approximately 160-170 during the years 1978/79-1983/84 to 100-120 during the period 1984/85-1989/90.

The lack of new blood in the system brought about a significant process of upgrading in rank and aging of staff. In 1989/90 almost 28% of the senior academic staff were at the rank of full professor, compared with only 19% in 1978/79. The size of the staff at the rank of associate professor also increased significantly - from 22% in 1978/79 to 27% in 1989/90. These increases at the top of the senior academic staff ladder were at the expense of the lower ranks. The number of senior academic staff at the rank of lecturer and senior lecturer decreased absolutely from approximately 2,000 in 1978/79 to approximately 1,800 in 1989/90, and their share of total senior academic staff dropped from 59% in 1978/79 to 45.5% in 1989/90.

TABLE 1

Senior Academic Staff in Universities Funded from the Normal Operating Budget, and their Distribution According to Rank and Age in Selected Years 1978/79 - 1989/90 (Full-Time Equivalents)

	1978/79	1983/84	1987/88	1989/90
Total Full-Time Posts	3,400	3,800	3,900	3,900
By Percentage	100.0%	100.0%	100.0%	100.0%
Full Professor	19.3%	23.4%	25.9%	27.7%
Associate Professor	21.6%	24.3%	26.5%	26.8%
Senior Lecturer	32.6%	31.9%	30.5%	28.5%
Lecturer	26.4%	20.3%	17.1%	17.0%
Computed Median Age	43.1[1]		48.2[2]	
Percentage Aged 40 and Below	37.8%[1]		21.3%[2]	
Percentage Aged Above 55	15.2%[1]		23.6%[2]	

Source: Israeli, Eli, Personnel Survey of Universities in Israel, 1978/79, PBC, Jerusalem 1982;
PBC, Annual Personnel Survey of Universities in Israel, PBC, Jerusalem.
Data supplied by the universities to the PBC on personel in universities by age, August 1987.

1 Refers to the annual average of all senior academic staff in full-time posts in all budgetary categories (ordinary, closed and research), also including external instructors at the rank of lecturer and above.

2 Refers to all senior academic staff in the universities in August 1987, by head-count. Although the basis of data for this year is not identical to that of 1978/79, there do not appear to be differences that would have a signficant influence on the trends in changes in the age of staff that is measured here.

Data on the age of senior academic staff members, collected as part of

the annual surveys of university manpower, is available only for 1978/79. But PBC data on university staff broken down by age, collected eight years later especially for the purposes of one of its sub-committees, allows us a point of comparison with the past. According to this data, the computed median age of academic staff members in August 1987 was 48.2, that is - an increase of five years over 1978/79. The percentage of academic staff members over the age of 55 increased by over half, reaching 24% in 1987. The percentage of academic staff members under the age of 40 decreased by about 44%, reaching 21% in this year.

Throughout this period of increasing tightness in the academic labor market, the Allon Fellowships program was the only significant and sustained specific measure introduced to alleviate the deleterious effects of this trend. We now turn to a brief description of the program.

2. Procedures and Scope of the Program

2.1 Procedures[2]

The Allon Fellowships are intended to promote scientific excellence in Israeli universities by ensuring them a continuous inflow of outstanding young researchers. It does this by supporting on a competitive basis the appointment of fellows as members of the senior academic staffs of universities, at the initial rank of lecturer or senior lecturer. The sole criteria for preference in the competition is the scientific excellence of the candidate, without respect to his institutional affiliation or field of specialization. This support takes the form of the average salary of a lecturer or senior lecturer, as the case may be, for three years, conditional on the satisfactory progress of the fellow in the institution where he is employed. Since 1989/90 the fellowship includes a one-time research grant amounting to about $25,000 for researchers in the experimental sciences and about $7,500 for researchers in theoretical fields. Prior to this date the fellowship covered salary costs only. After this three year period the university is

2 This subsection is based on an examination of the published rules and regulations of the Allon Fellowships, as they have developed over time, and internal documents relating to its operation found in the administrative files of the Allon Fellowships in the PBC.

obliged to employ the fellow in a tenure-track position funded from the ordinary budget of the institution, unless there are overriding academic considerations that prevent this.

Candidates for fellowships are presented to the PBC by the rectors of the universities. They must possess a Ph.D. before the start of the fellowship and must not have had an appointment in a tenure-track position in the academic staff of any university in Israel. In recent years this latter restriction has been lifted somewhat to allow for an appointment by the institution that has presented his or her candidacy, within one year prior to the final date for submitting candidates for Allon Fellowships (January 31). An academic appointment abroad does not disqualify the candidate. There is no explicit condition regarding the maximum age of the candidate, although the program is intended for young researchers.

Evaluation and selection of candidates is carried out by four selection committees, one each in the fields of humanities, social sciences, life sciences and exact sciences and technology, that are appointed each year by the PBC. Each committee is composed of four senior Israeli researchers in different areas of specialization and from different institutions, one of whom serves as chairperson. Each committee member has a copy of each candidate's file, including resume, list of publications and current letters of reference from three or more authorities in the field of the candidate, representing at least two different institutions from Israel or from abroad.

There is no pre-determined number of fellowships to be selected by each committee; each committee ranks the relevant candidates by priority. The final recommendation as to whom to grant fellowships is determined at a meeting of the chairpersons of the four selection committees and the chairman of the PBC. This final recommendation is presented to the PBC for approval. Each committee determines its own methods of ranking the candidates. They do not usually rank the full list of candidates in detail, but rather group them into two or three groups - superior, excellent, less excellent, etc. Members of the committees can and do consult with colleagues who do not sit on the committees as to the quality of the candidates.

2.2 The Scope of the Program

Tables 2 and 3 show the development of the program over time in terms of candidates, success rates scientific field. From its inception in 1978/79 through 1991/92 close to 1,000 candidates participated in the competition. Of these, a third were nominated for the fellowship. Over time the number of candidates submitted annually rose by about 60%, from 50 in the first two years of operation to about 80 since 1988/89, while the number of fellows selected doubled, from 15-16 to 30-32. As a result, the success rate rose from 28% in the years 1978/79-1982/83 to approximately 37% since 1986/87. The rise in the number of fellows selected and in the success rate took place during the period when the academic labor market tightened significantly. If we compare the number of fellows selected to our estimate of the number of new academic appointments, mentioned above, Allon fellows represented 18-30% of the new appointments in the years 1984/85-1989/90, as opposed to only 9-13% in the years up to and including 1983/84.

The Allon Fellowships program is open to candidates in all scientific fields taught and/or researched in Israel's universities. Table 3 shows that, indeed, the candidates and fellows nominated represent a broad spectrum of fields. A more detailed analysis shows that the shares of candidates at the aggregate field level were fairly proportionate in most fields to the distribution of senior academic staff and changes in student numbers over the period. However, at the more detailed field level candidates tended to concentrate in the basic arts and sciences, as opposed to professional fields such as law, education business administration and para-medical studies. Likewise, at the aggregate field level, engineering appears to be underrepresented in the Allon program. This seems to be the result of self-selection on the part of the universities, in view of the stress placed on achievements in basic research by the selection committees.

Success rates differed significantly among fields. They were consistently high in mathematics and low in engineering and the social sciences. In the years since 1984/85 the success rate of candidates in the arts and humanities has also been especially high.

TABLE 2

Candidates for Allon Fellowships 1978/79 - 1991/92
by Year and Status

	Total Number of Candidates	Fellow-ships Awarded	Unsuccessful Candidates	Fellows as Percentage of All Candidates
1978/79	52	15	37	28.8
1979/80	51	16	35	31.4
1980/81	72	20	52	27.8
1981/82	80	20	60	25.0
1982/83	71	20	51	28.1
1983/84	65	23	42	35.4
1984/85	70	23	47	32.9
1985/86	72	24	48	33.3
1986/87	69	26	43	37.6
1987/88	68	27	41	39.7
1988/89	84	30	54	35.7
1989/90	76	24	52	31.5
1990/91	76	30	46	39.5
1991/92	88	32	56	36.4
Total	994	330	664	33.2

TABLE 3

Candidates for Allon Fellowships 1978/79 - 1991/92
According to Scientific Field

	1978/79 - 1983/84		1984/85 - 1989/90		1990/91 - 1991/92	
	% of Total	Success Rate	% of Total	Success Rate	% of Total	Success Rate
Total	100.0	29.2	100.0	35.1	100.0	37.2
Arts, Humanities and Law	28.6	26.8	21.9	40.6	15.9	46.2
Social Sciences, Business Administration and Education	18.9	25.7	21.6	30.5	18.3	26.7
Life and Medical Sciences	21.0	15.9	18.9	41.0	23.8	35.9
Mathematics & Computer Sciences	9.5	51.4	10.5	41.3	9.1	46.7
Physical Sciences	11.0	46.5	18.9	32.5	23.2	39.5
Engineering	11.0	30.2	8.2	16.7	9.8	31.3

3. The Career Development of the Candidates

In this section we examine the academic career development of candidates who participated in the program up through 1988/89. It is based on the results of a survey questionnaire sent to the academic institutions that submitted the candidates and/or employed them regarding the employment history of the candidates up through October 1990, and their last known place of work if they were not employed by the institution on this date.

3.1 Initial Employment in the Submitting Institution

In this subsection we look at whether the candidates began to work in a regular academic track position of the senior academic staff of the university that submitted their candidacy. A few words of introduction are perhaps in order.

The selection for an Allon Fellowship creates an asymmetric relationship between the candidate and the submitting institution. As mentioned above, the institution obligates itself, vis-a-vis the PBC, to employ the fellow and appoint him to an academic tenure-track position on or before completion of the three-year fellowship, unless there are serious academic reservations to such an appointment. The candidate selected for a fellowship has no such obligation and may, for reasons of his own, decline the fellowship and seek employment elsewhere. With regard to an unsuccessful candidate, neither the candidate nor the institution is under any obligation to the PBC to enter into an employer-employee relationship.

Table 4 shows that 91% of the candidates selected for the fellowship in the period 1978/79-1988/89 accepted it and began to work in the institution that submitted them. Of the 22 candidates who declined the fellowship, during this period, nine decided to accept employment in another university in Israel and thirteen found employment abroad. With regard to the unsuccessful candidates, the majority (approximately 73%) were initially employed by the submitting institution. Of those not employed by the submitting institution, 16% moved on to another Israeli university, 18% were employed in a position outside of the regular academic track in the submitting institution or in an Israeli research institute, 14% found employment in another sector (industry, etc.) in Israel, 22% went abroad, and with regard to the remainder there was no information in the institution as to

their whereabouts.

Over time there was a decline in the share of unsuccessful candidates hired by the submitting institution from 75% of the candidates submitted in the competition years up through 1983/84 to 70% thereafter. In view of the tightening academic labor market in Israel in the latter half of the 1980's, this result is not surprising. It would seem reasonable to provide the same explanation for the rise in the number of unsuccessful candidates who left Israel in the latter half of the 1980's as opposed to the first half. However, the high percentage of unsuccessful candidates in the "other and not known" category in the period up through 1983/84 may be concealing some additional researchers who left Israel for employment abroad. What is certain is that at least 5.7% of all candidates submitted through 1988/89 either remained abroad or left Israel before beginning to work in the institution that submitted them.

3.2 Attrition After Initial Employment

The receipt of an Allon Fellowship did not provide a direct monetary advantage to fellows beginning their academic careers in an Israel university, as opposed to unsuccessful candidates. Throughout the period relevant to this part of the study, i.e. - through the 1988/89 competition year, the fellowship covered the average salary costs of the fellows for up to three years. Supplementary funds for research expenditures were introduced in 1989/90. However, the fellowship did provide a considerable advantage with regard to employment security in the submitting institution, as mentioned above.

It should be mentioned here, though, that this job security is relative and not absolute. Lecturers in Israel are non-tenured and within five or six years at most or leave the regular academic tract. The same non-tenured status is given in many cases to academic staff entering the university at the rank of senior lecturer. Fellows have to undergo the same institutional evaluation process as their unsuccessful colleagues in order to obtain tenure.

TABLE 4

Initial Employment of Candidates by Status and Year of Competition

	1978/79 - 1983/84		1984/85 - 1988/89	
	Unsuccessful Fellows	Candidates	Unsuccessful Fellows	Candidates
Total	114	277	130	230
Of these:				
Initial employment at submitting institution	104	207	118	161
Percentage of Total	91.2%	74.7%	90.8%	70.0%
Not initially employed by submitting institution	10	70	12	69
Percentages of these by:				
Last Known Place of Employment	100%	100%	100%	100%
Other university in Israel	50.0%	12.9%	33.3%	18.8%
Research institutes in Israel*	-	17.1%	-	18.8%
Other sector in Israel	-	15.7%	-	13.0%
Abroad	50.0%	15.7%	66.7%	27.5%
Other & not known	-	38.6%	-	21.7%

* Includes employment in submitting institution in non-regular academic track position.

Table 5 shows that there was no significant difference between the attrition rates of fellows as opposed to unsuccessful candidates. Approximately 23% of both fellows and unsuccessful candidates who competed in the program in the period 1978/79-1983/84 and began working in the submitting institution left the institution within their first seven years of employment. There were, however, significant differences between fellows and unsuccessful candidates who left in terms of their present place of work. Almost 63% of the fellows who left went abroad, whereas for unsuccessful candidates 26.5% went abroad. Almost half of the unsuccessful candidates found employment in a sector outside of academia in Israel, or there was no information in the institution on their present whereabouts, whereas only a sixth of the fellows who left were in this category.

There is no apparent difference between the two groups in terms of the duration of employment of those who left. Approximately a third of those who left in both groups did so within their first three years of employment and the remaining two-thirds in the years four to seven. These latter years are critical with regard to their future in academia, as they are the years in which decisions regarding tenure are made. Indeed, an examination of fellows who left for abroad in the years four to seven showed that the majority of them had not received tenure.

The overall level of attrition might seem low considering the extremely tight academic labor market in the latter half of the 80's and the fact that the candidates began working in non-tenured positions.[3] However, the high level of emigration of researchers, especially among the fellows, is a cause of concern. Over 14% of the Allon fellows who began work in the submitting institution in the period covered left Israel within seven years of employment. If we include candidates selected for a fellowship who did not begin work at the submitting institution (see sect. 3.1 above), then close to 18% of the candidates selected for Allon Fellowships over the years 1978/79 - 1983/84 did not come to Israel or left within seven years. The corresponding figure for unsuccessful candidates was 6% and 9%.

3 Nvo-Ingbar found an attrition rate of 3.9% annually over the period 1976/77-1983/84 among academic track staff in the up-to-40 year old age group of the faculties of natural sciences and technology of Israel's universities in 1975/76. The parallel figure for our study (not including attrition candidates who moved from one Israeli institution to another) was 2.8% for all fields and 3.6% in the fields covered by Nvo-Ingbar.

TABLE 5

Candidates from the 1978/79 - 1983/84 Cycles
Who Began to Work in the Submitting Institution and Left it
Within Seven Years of Start of Employment,
By Rank, Time of Leaving and Last Known Place of Employment

	Total		Fellows		Unsuccessful Candidates	
	Abs. Number	Percentages	Abs. Number	Percentages	Abs. Number	Percentages
Total Candidates Who Began To Work in Submitting Institution	311	100.0	104	100.0	207	100.0
Of These:						
Still in Institution After 7 Years	238	76.5	80	76.9	158	76.3
Left Within 7 Years	73	23.5	24	23.1	49	23.7
Total Leaving	73	100.0	24	100.0	49	100.0
Of These:						
To other Israeli University	18	24.7	5	20.8	13	26.5
For abroad	28	38.4	15	62.5	13	26.5
Other1	27	37.0	4	16.7	23	46.9
Time of Leaving:						
Within 3 Years - Total	23	31.5	8	33.3	15	30.6
To other Israeli University	5	6.8	1	4.2	4	8.2
For abroad	7	9.6	6	25.0	1	2.0
Other	11	15.1	1	4.2	10	20.4
4 Years or Later - Total	50	68.5	16	66.7	34	69.4
To other Israeli University	13	17.8	4	16.7	9	18.4
For abroad	21	28.8	9	37.5	12	24.5
Other	16	21.9	3	12.5	13	26.5

1 Includes two fellows and nine unsuccessful candidates whose last place of employment is unknown.

4. Academic and Scientific Achievements of Candidates

The evaluation procedure used by the selection committees of the Allon Fellowships is an elaborate peer review system broader in scope but not unlike the decision process that the heads of every university faculty undergo annually to determine which candidate or candidates to appoint to an academic track position from among the many who have applied. The committees are guided by the past experience and achievements of the candidates, generally obtained under the close guidance and direction of a Ph.D. or post-doctoral supervisor, to determine which candidates have the greatest potential to develop into outstanding independent scientists in their own right during an extended academic careeer that can last 30 years or more. Mistakes with regard to individual researchers are inevitable in such a decision system; but one can expect that if the relevant information was gathered and properly analysed and weighed by the selection committees, then the candidates selected for the Allon Fellowship as a group would outperform the group of non-successful candidates.

In this section we attempt to distinguish between the performance of fellows and unsuccessful candidates on two central measures of a successful academic career:

1. their standing on the academic rank ladder;
2. their scientific outputs and its impact on their scientific peers.

Though obviously related, we examine each one separately at this stage in our work. The analysis of academic rank relates to candidates in all scientific fields, whereas the analysis of scientific outputs and impacts relates only to candidates in the natural and engineering sciences for which we were able to gather the relevant information.

4.1 Academic Rank of the Candidates

All told, 537 of the 751 candidates (71.5%) submitted to the Allon Fellowships program over the period 1978/79 -1988/89 were employed in an academic track position in an Israeli university (not necessarily the one that submitted their candidacy) in October 1990. Of these, 206 were fellows and 331 were unsuccessful candidates, which represented 84.4% and 65.3% respectively of all fellows selected and unsuccessful candidates submitted during this period. The breakdown of these two groups as to rank in effect in October 1990 is

shown in Table 6. Close to 4% of the candidates had already managed to rise to the rank of full professor, a quarter to the rank of associate professor, 46% were senior lecturers, and the remaining quarter lecturers. The share of fellows at each rank rises as we move up the ladder to 47.5% at the rank of associate professor and 80% at the rank of full professor. Other preliminary indications that fellows may have moved up the academic ladder quicker than unsuccessful candidates can be gleaned from the fact that of those candidates at the rank of associate professor in October 1990 the average number of years from receiving their doctorate to reaching this rank was 8.5 for fellows, which was significantly smaller than the average of 9.9 years for unsuccessful candidates.

In order to examine whether our hypothesis that fellows did indeed move up the academic rank ladder faster than unsuccessful candidates, we used stepwise multiple regression analysis. The dependent variable that we tried to explain was the current rank of the candidate (CURRANK) where the regression equation can take on values of 1 (lecturer) to 4 (full professor). Upon a detailed statistical analysis of the current rank of candidates according to various variables for which we had information, we selected the following parameters as our independent variables:

Status - a dummy variable, where 0=unsuccessful candidate and 1= fellow. We expect a positive relationship between this variable and CURRANK.

YRSDOC90 - The number of years from receiving the Ph.D. until 1990. This variable gives expression to the age of the candidate as a professional researcher. The greater his age, the higher we expect his academic rank to be.

Sex - 0=female, 1=male. A positive relationship to the dependent variable is expected.

The scientific field of the candidate appeared to be an important explanatory variable of current rank. We divided the scientific fields into three, as follows:

DUMSOC - 1=social sciences and humanities, 0=otherwise. Our study showed that candidates in these fields almost always enter the senior academic staff at the rank of lecturer, as opposed to the other fields where the majority, or a significant share, begin at senior lecturer. We

TABLE 6

Candidates Employed by Israeli Universities
At Beginning of 1990/91 - By Academic Rank and Status

	Total Abs. Number	Percentages	Fellows Abs. Number	Percentages	Unsuccessful Candidates Abs. Number	Percentages
Total	537	100.0	206	38.4	331	61.6
Lecturer	131	100.0	35	26.7	96	73.3
Senior Lecturer	247	100.0	89	36.0	158	64.0
Associate Professor	139	100.0	66	47.5	73	52.5
Full Professor	20	100.0	16	80.0	4	20.0

expected a negative relationship to CURRANK;

DUMMATH - 1=mathematics and computer sciences, 0= otherwise. Computer science is a relatively young field that grew quickly in Israeli universities in the 1980's. We expected a positive relationship to CURRANK.

The remaining fields are the life and physical sciences and engineering.

DUMINST - 1=The Weizmann Institute of Science or the Technion - Israel Institute of Technology, 0=otherwise. A higher proportion of candidates were at the rank of associate professor or above than at the other institutions. They also tended to give an initial rank of senior lecturer to their candidates more than other institutions. We expected a positive relationship to CURRANK.

The results of the regression were as follows: (numbers in parentheses are standard errors):

$$\underset{\quad}{\text{CURRANK}} = \underset{(0.108)}{0.767} + \underset{(.008)}{0.119}\text{YRSDOC90} - \underset{(.064)}{0.26}\text{DUMSOC}$$

$$+ \underset{(.054)}{0.36}\ \text{STATUS} + \underset{(.092)}{0.036}\ \text{DUMMATH} + \underset{(.069)}{0.2}\ \text{SEX} + \underset{(.072)}{0.19}\ \text{DUMINST}$$

$R^2 = .44$ $\quad$ $N = 537$

These results seem quite satisfactory considering the small number of values taken on by the dependent variable and the fact that we introduced only one independent variable that is even remotely connected to the activities of the researcher throughout his career - i.e., YRSDOC90. This variable turned out to be the most important of the variables in our model in terms of its explanatory power ($R^2 = 27.4\%$) and its positive influence on CURRANK. The next variable to enter the equation was DUMSOC which added 7.9% to the R2 and was negatively related to CURRANK, as expected.

The third variable to enter the model was Status, which added 5.8% to the explanatory power of the model. The strongly positive b coefficient, representing more than a third of a rank, lends support to our hypothesis. The remaining variables are all of the expected sign.

Together they add only 3% to the explanatory power of the model.

The academic career path in Israel is rather structured at the start and becomes increasingly diffuse thereafter. As mentioned above, lecturers in Israel are non-tenured and must move up to the tenured position of senior lecturer within five or six years at most or leave the regular academic track. The same non-tenured status is given in many cases to academic staff entering the university at the rank of senior lecturer. Upon receiving tenure, researchers can and do get stuck at the level of senior lecturer or associate professor for extended periods of time. It is possible, then, that the model we developed in general, and the status variable in particular, was explaining the movement from lecturer to senior lecturer[4], which, as we mentioned above, was the rank of almost half of the candidates in October 1990.

We therefore ran an additional regression, this time restricting ourselves to candidates at the level of senior lecturer and above. The results corroborated our suspicions in part. The R^2 dropped by over 12% but this was due entirely to the drop in the explanatory power of YRSDOC90. The passage of time was, indeed, a far less important factor in explaining the differences in the current rank of candidates from the rank of senior lecturer and above. The explanatory power of Status, however, actually rose somewhat. This lends further support to our initial hypothesis, as it shows that fellows advanced more quickly than unsuccessful candidates at the professorial levels, i.e. - even when the candidates had already reached an advanced stage in their careers.

There remains, however, a distinct possibility that what we are measuring in our Status variable is the effect of an initial advantage gained by fellows over unsuccessful candidates on the basis of their achievements prior to receiving the fellowship and not necessarily, as we have intimated, the result of their outachieving unsuccessful candidates in the period subsequent to the receipt of the fellowship. We tried to examine this possibility directly by specifying a regresssion model to explain the initial rank of the candidate in the submitting institution. The new dependent variable of initial rank is dichotomous, as it can take on only one of two values - 1 (lecturer) or

4 Almost two-thirds of the fellows and three quarters of the unsuccessful candidates entered the senior academic staff at the rank of lecturer.

2 (senior lecturer) - of whom approximately 70% were at the level of lecturer. This, then, is an intrinsically difficult variable to explain. The model we adopted was similar to the one used above, with the major difference that we exchanged the YRSDOC90 variable with a variable that measured the period of time from the receipt of a Ph.D. until the candidate began working in the submitting institution. Our model registered an R2 of .35, which, under the circumstances mentioned above, is reasonable. Status, as above, was the third variable to enter the equation, but the additional explanatory power it provided was only 2% and its b coefficient was quite small (0.12). Whether this outcome can be viewed as evidence of a positive but weak initial advantage of fellows over unsuccessful candidates that grew over time, based on the subsequent achievements of fellows, or as an incomplete estimate of the true relationship between status and initial rank, emanating from the statistical problems involved in specifying such a model, is open to interpretation. What is clear, though, is that fellows do maintain an advantage over unsuccessful candidates from their entry into the regular academic track in an Israeli university throughout their careers, which expresses itself in their current rank on the academic ladder.

In this section we have tried to infer the existence of achievements of fellows subsequent to receiving the fellowship that would warrant their rise up the academic ladder ahead of unsuccessful candidates. In the following section we attempt to measure some of these achievements directly, i.e. - the candidates' scientific output and impact.

4.2 **Scientific Output and Impact**

In this section we examine the scientific outputs of candidates subsequent to their beginning to work in the senior academic staff of an Israeli university, and the impact of these outputs on the international scientific community. As an indicator of scientific outputs we use articles appearing in journals covered by the Science Citation Index (SCI), while the citations to these articles are used here as an indicator of their scientific impact. Our analysis is restricted to the fields of mathematics and computer science, the life and physical sciences and engineering, which are covered by the SCI.

The theoretical and practical problems involved in the use of articles and their citations as indicators of scientific output and impact have been summarized and discussed by Martin & Irvine and Moed, et al. Most of the problems arise when one attempts to evaluate the

performance of individual researchers, but become less serious as the size of the group evaluated increases. Specific problems also exist with regard to the use of the SCI or other bibliometric databases to obtain data on individual researchers, due to the incomplete coverage of the SCI and the technical difficulties involved in properly matching the publication data in the SCI to their authors.

The issue of the coverage of Israeli publications in the SCI was examined in a recent study performed by the Samuel Neeman Institute. It shows that the SCI coverage of Israeli publications in the broad fields of physics, chemistry, mathematics, life sciences (medicine and agriculture were not included), mechanical engineering and electronic engineering, is quite high. The journals included in the SCI-derived Database of Israeli Scientific Publications reprsented over three-quarters of all publications and over 80% of the journal articles published close to 250 researchers over the years 1973-1984 in the study sample (Frenkel et al). In addition, the Neeman Institute, which prepared the data used in this section, took great care to ensure the proper matching of the data. Information gathered in this study on the name, full address, scientific field and years of employment were checked against every relevant publication individually, and only when they matched fully the data on the publication were they included as a publication of the candidate.

Nevertheless, caution is warranted in viewing the results. Our groupings are not large, so that substantial errors with regard to a few scientists can affect the results. In addition, publication and citation patterns can differ significantly among subfields within the aggregate fields we are using here, which can also confound the results. We have no reason to suspect that such problems, if they do exist, should favor in a systematic way either fellows or unsuccessful candidates.

The analysis included all candidates submitted through the year 1985/86 who had worked at least four years in an Israeli university up until 1988/89, even if afterwards they left the Israeli university sector for another sector in Israel or emigrated. Data was gathered on all the publications of these candidates from the calendar year overlapping the majority of the academic year in which they began to work (i.e., 1986 for 1985/86) through 1989 or the year in which the candidate left the Israeli university sector. Citation data was counted for each publication in the year of publication and the two years subsequent to publication. As a result, the data on citations was further restricted to

include only publications through 1987 of candidates who had been submitted up through 1983/84 and had worked at least four years, up until 1986/87.

On the basis of this information, we developed a series of indicators to examine the scientific output and impact of the candidates from varying aspects. These indicators are:

1. average publications per candidate per year;
2. cited articles;
3. average citations per candidate per year;
4. average citations per paper per candidate.

Finally, we developed a composite indicator based on the ranking of each candidate on indicators 1, 3 and 4 above. In addition, we included a ranking of the candidates in terms of their most cited paper in the period covered. Each indicator was given equal weight in the composite indicator and the candidates were ranked on the basis of their total score. Those candidates excelling in all or most of the aspects measured, of output and impact, appear at the top of this ranking, whereas those candidates who performed poorly on all or most of these indicators appear at the bottom.

The results were calculated separately for the first four years of employment and for all the relevant years that the candidate was employed. The results were generally similar and we present here only the results for all years. In addition, we tested on a more restricted sub-population whether extending the years of citing from three years to seven years would significantly change the results. We found that in almost all cases the results were either unchanged or strengthened by extending the period of citation counting to seven years.

The results of our analysis are summarized in Table 7. They show that fellows as a group outperformed the corresponding control group of unsuccessful candidates in terms of scientific outputs and impact in the fields of mathematics, life sciences and physical sciences. On the other hand, in engineering the unsuccessful candidates led the fellows in terms of outputs and were similar to them in terms of various impact indicators.

In order to examine the distributions of the two groups among the highest and lowest performers we broke the results of each indicator

down into quartiles and show in Table 7 the number of candidates appearing in the upper quartile and in the lowest quartile. To make these figures more meaningful, we developed an intensity index which is based on the share of each group within the relevant quartile, divided by its share of total candidates. An intensity index above 1.00 in the upper quartile means that a higher than proportional share of that group were among the top performers for that indicator. The results show that in the life and physical sciences fellows were relatively abundant in the upper quartile of the output and impact indicators and relatively scarce in the lowest quartile. The opposite was true for engineering. In mathematics fellows dominated the upper quartile, but a proportionate share consistently appeared in the lowest quartile of the output and impact indicators.

The results for the composite indicator, which is a comprehensive measure of performance in both outputs and impact, are in total congruence with the results of the individual indicators. Indeed, inspection of the ranked lists of candidates on various indicators shows that those candidates appearing at the top of the list of articles per year are usually also at the top of the lists of the various impact indicators, and likewise for those at the bottom of one of the lists.

TABLE 7

Various Indicators of Scientific Output and Impact
by Scientific Field and Status

	Mathematics		Life Sciences		Physical Sciences		Engineering	
	Fellows	Unsuccessful Candidates	Fellows	Unsuccessful Candidates	Fellows	Unsuccessful Candidates	Fellows	Unsuccessful Candidates
1. Articles per Candidate per Year[1]								
Total Candidates	22	17	19	59	22	26	10	16
Total Articles	316	151	298	978	623	403	115	258
a. Mean	2.73*	1.47	3.17*	2.75	4.41*	3.01	1.68	2.31**
b. Median	2.0	1.6	2.3	2.2	4.3	2.8	1.8	2.1
c. Candidates in Upper Quartile	9	1	5	15	9	3	2	5
Intensity Index[3]	1.61	0.23	1.04	0.99	1.63	0.46	0.76	1.15
d. Candidates in Lowest Quartile	5	5	3	17	4	8	4	3
Intensity Index[3]	0.89	1.14	0.63	1.12	0.72	1.24	1.50	0.69
2. Cited Articles[2]								
Total Candidates	16	12	10	47	17	15	9	13
Total Articles	156	104	181	640	415	219	92	187
a. Percent of Candidates Cited at Least Once	87.5	91.7	100.0	87.2	100.0	93.3	88.9	100.0
b. Percent of Articles Cited at Least Once	66.7	50.0	65.8	65.0	84.6	80.8	62.0	55.6
c. Articles in Upper Quartile of Cited Articles	32	7	48	79	88	44	17	23
Intensity Index[3]	1.23	0.54	1.73	0.79	1.03	0.94	1.30	0.87
3. Citations per Candidate per Year[1]								
a. Mean	3.7*	1.7	23.1*	9.5	27.5*	13.3	4.0	3.9
b. Median	2.7	1.8	9.2	5.0	19.0	12.8	2.5	2.3
c. Candidates in Upper Quartile	6	1	4	10	7	1	2	4
Intensity Index[3]	1.51	0.33	1.61	0.87	1.66	0.28	0.80	1.14
d. Candidates in Lowest Quartile	4	3	2	12	2	6	3	3
Intensity Index[3]	1.00	1.00	0.78	1.05	0.47	1.60	1.22	0.85

.../

TABLE 7 - Continuation -

	Mathematics		Life Sciences		Physical Sciences		Engineering	
	Fellows	Unsuccessful Candidates	Fellows	Unsuccessful Candidates	Fellows	Unsuccessful Candidates	Fellows	Unsuccessful Candidates
4. Citations per Publication per Candidate[1]								
a. Mean	2.6	2.3	7.8*	4.6	7.8*	5.3	2.5	2.4
b. Median	2.2	1.7	6.0	3.5	5.9	5.0	2.1	1.6
c. Candidates in Upper Quartile	5	2	5	9	6	2	2	4
Intensity Index[3]	1.25	0.67	2.0	0.78	1.42	0.53	0.80	1.14
d. Candidates in Lowest Quartile	4	3	2	12	2	6	3	3
Intensity Index[3]	1.00	1.00	0.78	1.05	0.47	1.60	1.22	0.85
5. Composite Indicator[4]								
a. Candidates in Upper Quartile	6	1	4	10	6	2	2	4
Intensity Index	1.50	0.33	1.59	0.87	1.42	0.53	0.81	1.13
b. Candidates in Lowest Quartile	4	3	2	12	2	6	3	3
Intensity Index	1.00	1.00	0.79	1.05	0.47	1.60	1.22	0.85

Source: Tabulations performed by the S. Neaman Institute for Advanced Studies in Science and Technology on data from the Science Citation Index.

* $p<.01$ ** $p<.05$

1 Population for output indicator is articles through 1989, or last year employed in an Israeli university, of candidates submitted through 1985/86 who worked at least four years up till 1988/89.

2 Population for citation indicators is articles through 1987, or last year employed, of candidates submitted through 1983/84 who worked at least four years up till 1986/87.

3 Intensity index is equal to share of candidates or articles in quartile divided by share of total candidates or articles.

4 Population of candidates as in Footnote 2. The output indicator is based on articles through 1989 or last year employed while, citation indicators are based on articles through 1987 or last year employed. See text for explanation of this indicator.

5. Summary, Discussion and Conclusions

The Allon Fellowships program was established in response to the general austerity that reigned over Israel's higher education sector from the mid-1970's. As the austerity deepened and the academic labor market tightened in the 1980's, the program grew in scope until, by the end of the 1980's, it appears that the majority of new appointments to university posts were taken up by Allon fellows or unsuccessful candidates of the program. The goal of the program was to ensure the absorption of a new generation of outstanding young researchers in Israeli universities and thus maintain Israel's tradition of scientific excellence.

The program was based on a number of incentives. For the university it provided interim financing to pay the salaries of new appointments until permanent financing could be arranged. For the candidates it provided a relatively high degree of job security in which to pursue their scientific work in an overall environment of strong competition for every open post. Increasingly over time, a third variable has entered the incentive equation, namely the prestige of being selected. As the academic labor market expands and public funds for higher education in Israel becomes more readily available in the 1990's, this last incentive will dominate the interest in the program and the characteristics and scope of the program will likely change accordingly. As a result, the ability to select the better candidates will become of increasing importance in the future.

In this paper, therefore, we have attempted to examine how the academic career development and achievements of candidates selected for Allon Fellowships in the past can enlighten us on this issue. As a control group for this examination we chose to use those candidates submitted by the universities for Allon Fellowships that were not selected. An alternative would have been to use the entire population of new appointments to academic track posts in universities over the relevant period. In addition to the ready availability of relevant information on unsuccessful candidates, our decision was based on the fact that the unsuccessful candidates had undergone a selection process on the part of the universities and were found more worthy with regard to their scientific achievements and potential for submission to the competition than the other young researchers that the university was interested in hiring.

We examined the current academic rank of the candidates employed by Israeli universities in October 1990 and found that fellows did move up the academic ladder on average faster than unsuccessful candidates. This

advantage was apparent at the higher echelons of the academic rank ladder and not only in the movement from lecturer to senior lecturer. We found that this advantage was due, in part at least, to the achievements of the fellows prior to receiving the fellowship. It seems that not only the selection committee was impressed by these achievements, but that the university employing them also took this into account in determining the initial rank at which they entered the regular academic track of the senior academic staff. We were unable to determine whether this initial advantage was increased upon, maintained or deteriorated somewhat over time.

It is important to note, though, that even if we could show that the initial advantage of fellows, in academic rank, increased over time, it would not necessarily be an indication that fellows had outperformed unsuccessful candidates in the period subsequent to the receipt of the fellowship. It could be that the universities advanced fellows more quickly than other researchers simply because of their prestigious status as fellows. One method we considered to check this possibility was to look at the advancement of candidates selected for a fellowship who turned it down for a post in another Israeli university. (The fellowship cannot be transferred from one university to another one). There were, however, only nine such cases and it seems likely that quick advancement was included among the incentives put forth to lure the candidates away from the submitting institution.

In this light, the supplementary examination of scientific outputs and impact takes on added significance. It appears to show that in the period subsequent to the receipt of the Allon Fellowship fellows, as a group, did outperform unsuccessful candidates in both of these objective measures in three of the four fields examined. While not eliminating the alternative interpretation entirely, as the institutions may have provided fellows with better research facilities, etc. than unsuccessful candidates[5], it does tend to further dampen its credence.

This examination, however, covered in the main only candidates from the cycle years up through 1983/84 and did not relate at all to candidates in the humanities and social sciences, who represent over 40% of all candidates. The results of this examination must also be viewed with caution for the reasons mentioned in section 4.2 above. We are therefore considering, as a final stage of our study, to perform a post-peer review exercise of past

5 In this context, it should be mentioned that the PBC also gave preference to Allon Fellows in a Fund for Scientific Equipment that it managed up till 1988/89.

candidates, asking leading scientists in the various fields to rank them in terms of their scientific merit at present.

References

Frenkel, Amnon, Aner Shoham & Gideon Czapski (1991). *Cooperation Between Israeli and Foreign Scientists in the Experimental and Engineering Sciences.* (Haifa, the S. Neaman Institute for Advanced Studies in Science and Technology, Technion - Israel Institute of Technology). (Hebrew).

Kidd, Charles (1981). "New Academic Positions: the Outlook in Europe and North America". Science, 212, pp. 293-298.

Martin, Ben & John Irvine (1983). "Assessing Basic Research - Some Partial Indicators of Scientific Progress in Radioastronomy". *Research Policy,* 12, pp. 61-90.

Moed, H.F., W.J.M. Burger, J.G. Frankfort & A.F.J. Van Raan (1985). "The Use of Bibliometric Data for the Measurement of University Research Performance". *Research Policy,* 14, pp. 131-149.

Nvo-Ingbar, J. (1987). *Faculty in Science and Technology: Career Patterns in Changed Academic Markets,* unpublished research report. (Jerusalem, National Council for Research and Development, Ministry of Science and Technology). (Hebrew).

FURTHER INVESTIGATIONS IN

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Edited by ***Bluma C. Peritz***

This publication includes two papers presented at the **"Info 92"** Conference, the Israeli Information week in the framework of the session on "The Evaluation of Scientific Activity - Methods and Tools" organized by the S. Neaman Institute.

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The S. Neaman Institute
Technion City, Haifa 32000, Israel
Tel. 04-237145, Fax. 04-231889

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