Ministry of State

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SCIENTIFIC MANPOWER IN THE FEDERAL GOVERNMENT (PHASE I)

internal report

rapport interne

Second draft

SCIENTIFIC MANPOWER IN THE FEDERAL GOVERNMENT (PHASE I)

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Government Projects Division
Government Branch
November 1977

TABLE OF CONTENTS

SUMMARY

Introduction

With respect to federal scientific manpower, the 1970s have been a period of heightened expectations on the part of both government and scientists. The federal government has been emphasising priorities and mission-oriented research; the scientists, have been asking for a clearer alignment of these expectations with job-specifications, performance standards and other reward mechanisms.

The change in government's expectations of its scientific manpower is reflected in an increasing concern to relate a scientist's activity to the mission of his organization at all levels of government: Department, Service/Branch and the Research Establishment. Most of the emerging governmental priorities with a significant science and technology input, such as energy, food, oceans, natural resource management and public health protection, require an emphasis on problem orientation from the research personnel; in a broad sense, they can be described as priorities with applied research and engineering thrusts.

The second factor which has led to this change is the growing recognition of the fact that until recently weak linkages have existed between the scientists and the potential users of their research. Until the Senate Comittee on Science Policy started its enquiry, most scientists in government were confident that their mission benefitted either industry or science and the nation. The Senate Committee's hearings raised doubts and revealed uncertainties about how others perceived this mission.[1] Consequently, in recent years, the federal government has been evolving criteria to justify R&D activities carried out in federal laboratories. No longer can the value of research be assessed solely on the "quality" criterion but this evaluation should combine scientific excellence with the relevance of research to the Departmental mission and user needs.

Terms of Reference

This study was undertaken in response to queries by the Senate Committee on Science Policy to examine scientific manpower problems within the Public Service in view of the changing role of science within government over the past decade. The terms of reference for the first phase of the study are:

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[1] Senate of Canada, 1968-1969. Proceeding of the Special Committee on Science Policy, Nos. 15, 16, 17, 31, 63, Senate of Canada, 1970.

Science in a Changing Environment-Proposals for a Departmental Science Policy, Science Policy Branch, DOE, Jan. 1972, p. 11-17 to analyze recent statistical surveys and reports on scientific manpower in the federal government, and to identify and examine the major scientific manpower problems.

Definition: Public Service Scientific Manpower

The data used in this report to define scientific manpower is based mainly on the Public Service's occupational group classifications. Thirteen occupational groups from the "Scientific and Professional Category" have been identified as scientific. These include: Agriculture (AG), Biological Sciences (BI), Chemistry (CH), Defence Scientific Services (DS), Engineering (EN), Forestry (FO), Meteorology (MT), Medicine (MD), Pharmacy (PH), Physical Scientists (PC), Scientific Research (SE-RES & SE-REM), Scientific Regulation (SR), and Veterinary Science (VS). A minimum requirement for entrance into these groups is a Bachelor degree in natural sciences and membership in a professional association wherever appropriate.

Scope of Study

While developing a general profile of these occupational scientific groups (functions, age, salary-scales and mobility characteristics), the study examined:

- firstly, the change in expectations of the federal government as employer, as reflected in the governmental science and technology related priorities and departmental missions, and in emphasis toward combining "quality", "relevance" and "utilisation" criteria for evaluating government research.

- secondly, the suitability of existing performance assessment standards in view of the evolving role of scientific manpower; and whether these standards provide an adequate framework against which the level of performance can be measured.

- thirdly, whether research management structures can accommodate new changes, and if, at the same time, they encourage a two-way flow of ideas between the Department and the bench level scientist.

- finally, related special scientific manpower problems, e.g. age-distribution; and expertise required over the next 10-15 years in view of emerging S&T priorities.

I. Alignment of Changing Governmental Expectations and Manpower Job-Specification Standards

Until recently, the Treasury Board as the Public Service 'employer' through its selection and classification system, has stressed the recruitment of scientific personnel on the basis of scientific disciplines and has emphasized the quality of research performed rather than its value and relevance to departmental missions and governmental priorities. Job-specifications for a majority of scientific groups, instead of calling for flexibility and adaptability in performance, tend to support narrow specialisation and an inward orientation without adequate concern for the new thrusts emerging within and outside the Public Service.

A recent revision of the selection and classification manuals has been made by the Treasury Board Secretariat to update standards for the Scientific Research (SE) group. However, this appears to be a unique effort. The revised manual, by emphasizing relevance and productivity of research work, has identified standards for this group in isolation from other scientific groups. The classification systems of a majority of scientific groups merit careful attention to assess whether they provide adequate career paths for Public Service scientists in view of the emphasis by departments on relevance and productivity of research in line with missions, new priorities, and the governmental contracting out policy.

It is recommended that Treasury Board Secretariat in conjunction with major science oriented Departments, Public Service Commission and MOSST should seek to rationalise the selection and classification standards of scientific occupational groups, not individually but in a concerted manner. In this way, existing scientific groups would be classified in common terms on the basis of their scientific functions (research, regulation, interpretation, advice, and management), task-complexity, educational background and salary levels. Several common characteristics among these scientific groups exist which might permit consideration of their consolidation into fewer groups or even a single group like the Defence Scientific Services (DS).

II. Suitable Performance Assessment Standards and Reward Structure

Our examination suggests that in view of the evolving role of government science and technology to respond adequately to new needs, there are inconsistencies in the reward structure for scientific groups, in terms of both the performance appraisal system and the opportunity provided to scientists for moving upwards to other occupational groups or to other sectors.

With regard to appraisal systems, scientific groups in the Public Service are presently subjected to two types of performance assessment - (i) position-oriented, and (ii) person-oriented. In 'position-oriented' jobs, career progression is based essentially on standard annual increments tied to a general overall satisfactory performance. In 'person-oriented' jobs, the emphasis is on relating pay to a scientist's performance on a particular project, (e.g. using number of project related publications as a criterion for performance-assessment). At present, only two scientific groups, the Defence Scientific Services (DS) and the Scientific Research (SE) groups have 'person-oriented' performance-appraisal systems whereas the remaining groups are 'position-oriented'. The distinction between the two systems decreases at higher classification levels. A desirable system for all scientific groups would be one which skillfully blends both orientations, and is common for all scientific groups in the federal government.

A dual-ladder mechanism for providing alternative means of moving upwards in managerial or research occupations has been in effect within the SE group (e.g. RES and REM subgroups) for almost a decade. However, it is not clear as to why this choice of 'scientific/technical' or 'management' is confined to the SE group, and not extended to other scientific professional groups. There are other problems with this dual-hierarchy mechanism; for example, the two ladders may act solely as a means to obtain rewards for scientists rather than as an opportunity to widen job-responsibility, or as a shelf to accommodate staff lacking scientific and technical abilities.

This study has shown that Public Service scientific personnel tend to remain in their respective occupational groups for long periods, often until retirement. Even those who move, most often go to other scientific groups; their lateral movement to other occupations has been very limited. The mobility issue is complex and may be a symptom of broader research management problems such as the need for a suitable reward structure, a well-designed career path and appraisal system, and an open decision-making organization.

It is recommended that that the Treasury Board Secretariat in conjunction with major science-intensive Departments and MOSST should assess the need for restructuring the systems for evaluating the performance of public service scientists; and also develop mechanisms and opportunities for their movement within and outside the Public Service.

This study would include:

- evolving consistent performance-assessment standards for all scientific groups which would skillfully blend 'position' and 'person-oriented' appraisal systems.
- developing a more rationalized "dual ladder" mechanism which is not limited to the Scientific Research (SE) group, and permits early selection of those with managerial potential.
- developing opportunities and incentives to encourage scientists to rotate between 'scientific' and 'managerial' positions for short terms both within and outside the Public Service.
- extending current interchange programs with outside sectors to include members of the Scientific and Professional Category.

III. Appropriate Management Structures at Laboratory Levels

A primary requisite for effective functioning of an organization, as mentioned earlier is a reasonably clear enunciation of the employer's expectations, and the rewards offered to fulfill them. The nature of demands imposed on the organization sets the goals and motivates the individuals working within it. A little attention has been paid to the organizational structure itself and whether it can accommodate new changes. For this, it should be capable of facilitating communications among policy makers, managers and scientists and with those who are potential users of the research within and outside the federal government.

Although there is a good ratio of Research Manager (REM) to Research Scientist (RES) in the Public Service, 1 REM for 9 RES, the research managers have not always been successful in translating government priorities or departmental goals to laboratory missions. Instead they have tended to act as a 'shield' between laboratory personnel and headquarters. Such protective attitudes may be beneficial in the maintenance of morale in the short-term, but often lead to a situation where researchers are asked to comment on their redeployment to a new subject-area long after the final decision concerning their future has been made elsewhere. Similar problems are encountered when scientists are asked to get involved in technology-transfer at the completion of a project. This involvement would be beneficial at earlier stages - project planning or development.

It is recommended that major science intensive departments with MOSST should undertake reviews of the management structures at the laboratory level. This is in order to widen the bench-level scientist's knowledge-base, and to improve his appreciation of management problems, especially those pertaining to mission orientation and utilisation of research results.

A suggestion for introducing mechanisms for "rotational" or "limited term" positions has been made earlier. A great deal is still required to involve researchers in such relevant areas as project definition, portfolio planning, project control, resource allocation and general management.

Furthermore, attention should be given to evolving 'open' and 'flexible' research project teams. While combining the skills of a project manager, discipline head, and individual R&D worker under an R&D director, the multidisciplinary project management approach in some departments has helped to broaden the knowledge-base and experience of the participants, and thus provide them with more avenues for career progression. Serious consideration should be given to the appropriateness of organizational structures and especially to examining whether the research laboratory should be organized by scientific discipline or by an interdisciplinary management system.

IV. Special Problem-Areas

Age-distribution

Data are presented which show that in the short-term, the overall age-distribution of scientists within the Public Service is fairly balanced, with some skewing toward both the 26-35 year-old band and the mature scientists. The problem, however, is entirely different when viewed in the long-term, say over a 20 year period. If the present growth constraints continue, the proportion of younger scientists would decline while that of higher-age scientists, who now comprise the 26-35 year bulge, would increase.

This implies that there may not be adequate replacements by 1995, when the present 26-35 year old group is retiring. Furthermore, in a minimum growth situation, the small influx of fresh ideas could lead to intellectual stagnation within the research organizations, which could affect both their creativity and subsequent productivity. The problem requires further detailed examination to consider the supply and demand situation over this period in terms of new educational expertise required on a department to department basis.

It is recommended that consideration should be given to initiating a feasibility study in conjunction with the Public Service Commission and science-intensive departments to assess the statistical dimensions of the ageing problem in view of different scenarios for future growth of the Public Service. In addition, in association with the Treasury Board Secretariat, a study should be made of innovative mechanisms to facilitate a healthier age-distribution of scientific personnel in the Public Service in the longer term. The latter study would include consideration of:

- a program of post doctoral fellowships/research associateships on a tenure basis for federal laboratories similar to that currently in operation at the National Research Council, to overcome shortages of younger scientists;

- the creation of opportunities for federal scientists to diversify their talents and skills, and the development of mechanisms for temporary and permanent transfers outside the Public Service (e.g. industry, universities, provinces and outside Canada); and

- the introduction of voluntary early retirement schemes whereby a civil servant could choose to pursue a second career and continue to pay into the retirement fund of the Public Service without forfeiting benefits.

Changing Priorities and Required Expertise

In view of the growing concern within the federal government over issues pertaining to energy, oceans, natural resource management etc., and their longer-term implications, it is essential to find out if adequate scientific manpower will be available within Canada to match the future needs of federal science oriented departments. It is recommended that in conjunction with federal science oriented departments, MOSST should develop a mechanism for identification of departmental scientific manpower requirements over a 10-year period in line with changing government priorities and new missions.

Mechanisms for Implementation of Phase II

Two approaches are possible for implementing Phase II. Scientific manpower problems could be examined on an issue by issue basis with relevant departments and agencies. This would be very time consuming and would have the drawback of tackling the identified problems on a piecemeal basis. The second approach would be to set up a broad-based "Task Force on Public Service Scientific Manpower" to address the multiple dimensions of these scientific manpower problems. It is recommended that the task-force approach should be employed.

I. INTRODUCTION

In recent years, a growing concern to ensure a more dynamic and creative scientific community has been shown within the federal government. The Special Committee of the Senate on Science Policy (Chairman: the Honourable Maurice Lamontagne; P.C.) in its reports has persistently asked that MOSST "develop a program in cooperation with the Public Service Commission and the Treasury Board Secretariat to facilitate the mobility of R&D personnel within the government and between university, industry and public agencies, with special emphasis on transfers from government to industry".[1] This study has been initiated by MOSST in response to such queries to identify and define the major scientific manpower problems within the Public Service.[2]

The agreed terms of reference for the study are:

> To analyze recent statistical surveys and reports on scientific manpower in the Federal government, and to identify and examine the major scientific manpower problems.

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[1] The Senate Special Committee on Science Policy, A Science Policy for Canada, Volume II, Ottawa, 1972, p. 596

The Senate Special Committee on Science Policy, A Science Policy for Canada, Volume III, Ottawa, 1973, p. 798

Senate Debates, November 30, 1976

[2] Public Service employees in this report are those individuals for whom Treasury Board is designated as employer. In March 1975, for a total of 239,721 employees within the Central Administration, the Treasury Board acted as employer. Scientific agencies like the NRC and AECL are excluded because they are considered to be "separate employers".

II. SCIENTIFIC MANPOWER IN PUBLIC SERVICE

Occupational Categories and Groups

The data used in the study to define scientific manpower is based mainly on the Treasury Board's public service occupational group classification system. For selection, classification and evaluation the employees within the Public Service are divided into two levels of groupings: Occupational Category and Occupational Group.

The Occupational Category, the first level of grouping, is a broad horizontal division of the Service, useful for the planning and development of personnel policy. It is made up of occupational groups linked together in a general way by educational requirements and a common approach to classification and pay administration.

The second level, the Occupational Group, is a sub-division upon which the process of pay determination could be appropriately focussed. Each group comprises employees with similar skills who perform similar kinds of work, and bears a relationship to identifiable occupational groups in the outside labour market, wherever possible.

In addition, for each group extensive classification and selection standards have been developed which describe the agreed format for selection and evaluation of personnel for appointment to positions in a particular occupational group. The standards also provide a detailed framework against which the relative level of performance and job responsibility of employees may be appraised. In general, the standards seek to lay down the expectations of Treasury Board as employer.

There are six occupational categories within the Public Service: Executive; Scientific and Professional; Administrative and Foreign Service;Technical; Administrative Support; and Operational. These categories further consist of occupational groups and subgroups.[3]

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[3] Central Administration Categories for which Treasury Board is designated as Employer	Number of Employees March 1975
Executive	1,096
Scientific and Professional	21,428
Administrative & Foreign Service	42,746
Technical	23,190
Administrative Support	63,091
Operational	86,962
Unconverted (DRB)	1,208
	239,721

Source: Treasury Board, Manpower Status Report at the Start of 1975-76, March 1975.

Scientific Occupational Groups

A significant majority of scientific manpower belong to the 'Scientific and Professional Category'. Usage of the term scientific manpower in this report is limited to those occupational groups which are within this particular category, and comprise individuals with university level education in natural sciences and active involvement in the performance of either one or more of the following science-based functions. These functions are:

a) scientific research: basic, applied, developmental, experimental

b) scientific regulation: quality control, grading, testing etc.

c) scientific interpretation: surveys and explorations etc.

d) scientific management/advice: planning and evaluation etc.

Based upon application of the above functional criteria, of the 28 groups in the Scientific and Professional Category, only 13 may be presently identified as scientific groups.

These include:
- Agriculture (AG)
- Biological Sciences (BI)
- Chemistry (CH)
- Defence Scientific Services (DS)
- Engineering (EN)
- Forestry (FO)
- Meteorology (MT)
- Medicine (MD)
- Pharmacy (PH)
- Physical Scientists (PC)
- Scientific Research (SE): RES and REM sub-groups
- Scientific Regulation (SG): SRE sub-group
- Veterinary Science (VS)

Tables I and II highlight two main aspects of their manpower strength**: (i) their growth-pattern since 1965-66; and (ii) their concentration pattern in federal Departments.

**Manpower strength refers here to number of individuals/members in above mentioned occupational groups.

Table I Strength of Scientific Groups (1966/67 to 1975/76)

	65/66	66/67	67/68	68/69	69/70	72/73	73/74	74/75	75/76	% Increase 1966-76 to 1975-76**	% Increase 1972-73 to 1975-76
Agriculture (AG)	306	382	360	319	318	353	360	376	373	(-2%)	(6%)
Biological Sciences (BI)	1,062	429	410	417	419	584	644	686	657	(53%)	(13%)
Chemistry (CH)	218	168	175	158	185	364	393	407	401	(139%)	(10%)
Engineering (EN)	1,360	1,395	1,481	1,508	1,694	1,913	2,086	2,169	2,185	(57%)	(14%)
Forestry (FO)	336	175	194	201	192	127	129	126	113	(-35%)	(-11%)
Medicine (MD)	428	433	421	425	420	377	386	393	385	(-11%)	(2%)
Meteorology (MT)	487	535	554	645	633	591	642	648	629	(18%)	(6%)
Pharmacy (PH)	53	53	47	59	52	74	85	86	83	(57%)	(12%)
Physical Sciences (PC)	574	598	295	288	284	272	340	381	412	(-31%)	(51%)
Scientific Regulation (SR)	317	344	355	355	348	482	517	531	501	(46%)	(4%)
Scientific Research (SG)	---	982	1,420	1,588	914	2,119	2,193	2,261	2,231	(127%)	(5%)
Veterinary Science (VS)	466	465	464	475	504	540	542	556	562	(21%)	(4%)
Total	5,607	5,959				7,796			8,532	(54%)	(9%)

Sources: Treasury Board, "Separations in Relations to Strength" Reports for years 1965 to 70; 1972-73; 1973-74; 1974-75, and the Manpower Status Report At the Start of 1975-76, Manpower Division, Personnel Policy Branch, Treasury Board.

** Year 1965/66 omitted because number of positions from existing scientific groups that year were in process of being converted into the new Scientific Research (SE) group. This process took almost four years for completion.

Government Projects Division
Government Branch
MOSST
April 1977.

Table I (see page 3a) shows that of the 12 groups[4], the Scientific Research (SE) group had one of the largest increases (127%) over a 9-year period, 1966-76. This increase is second only to the changes taking place in the Engineering (EN) and Biological Sciences (BI) group, 57% and 53% respectively.

Such historical data fails to provide a true picture for it does not take into consideration the position of groups like Agriculture (AG), Forestry (FO), Physical Scientist (PC), Meteorology (MT) and Biological Sciences (BI) which were "converted" into Research Scientists (RES) when the Scientific Research Group was established in 1966.

A study of increases/decreases in the scientific manpower strength over the 1972-73 to 1975-1976 period provides a more realistic picture. By 1972, the conversion of positions from other groups to SE had been almost completed. This period is also significant because it marks the beginnings of budgetary constraints within the Public Service. For the SE group, the increase during 1972-1975, is only 5 per cent, a sharp contrast to the overall 127% increase (1966-67 to 1976-76). Similar changes, as shown in Table I, are noted for other scientific groups e.g. BI (13%), CH (10%), MT (6%)' PC (51%), FO (-11%). These frequent changes in the strength of scientific manpower reflect a lack of coordinated long-term manpower planning in this area.

Table II, points to the concentration of the scientific groups by major science-based Departments. It shows that approximately 70 per cent of the 12 groups are located in four Departments: Agriculture; Environment; Energy Mines & Resources; and the National Health & Welfare. From the Scientific Research (SE) group, 95% of Research Scientists (RES) and 90% of Research Managers are located within these four departments. Only two groups, Engineering (EN) and Scientific Regulation (SG) have a large number of their population in other departments. The EN group are located mostly in Communications; Transport; and Public Works, and the SGs are employed in Consumer and Corporate Affairs.

A general profile of the scientific groups can be developed by highlighting their four major characteristics:

- Functions
- Mobility
- Age
- Salary-scales

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4 The defence Scientific Service (DS) group joined the Public Service in 1974 after amalgamation of Defence Research Board into the Department of National Defence.

Table II Scientific Manpower Strength by Groups and Major Science-Based Departments

Science-intensive Groups / Departments	AG	BI	CH	ENG	FO	MD	MT	PH	SG	RES	REM	SUR	PC	VS	TOTAL
Agriculture	381	181	23	9	--	--	--	--	--	716	67	---	2	574	
Environment	--	404	124	406	90	--	614	--	--	676	113	12	205	--	
EM&R	--	--	35	60	--	--	--	--	9	416	41	129	262	--	
NH&W	--	122	171	7	--	254	--	51	--	110	27	---	--	20	
Other Depts.	13	111	90	1929	25	136	3	--	535	101	29	28	96	--	3170
TOTAL	394	818	443	2411	115	390	617	51	544	2019	277	169	565	594	9493

Source: Group and Level Profiles, 18-1-77,
Human Resources Planning Division, Public Service Commission

Projects Division, Government Branch
April 1977

It should be pointed out that data used here to develop such a profile does not aim at a precise statistical picture of scientific personnel, a task which is normally entrusted to statistical units within Statistics Canada, Public Service Commission, Department of Manpower and Immigration and the Forecasting Division of MOSST. With the exception of the Public Service Commission, the data base of these agencies seems confined to projecting supply and demand of scientific manpower.[5] Even the Public Service Commission data because of its dependence upon DATA STREAM printouts imposes certain limits on the scope of the analysis. For example, this centrally available data may allow an analysis of the age-distribution of Research Scientist (RES) sub-group, but will not allow a similar analysis by area of specialization.

For the purposes of this report, however, we have relied mainly upon the data resources of Public Service Commission's Human Resources Planning Division. They provide us with a sufficient information-base on which valid generalizations on scientific manpower problems in the Public Service can be made.

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[5] Department of Manpower, Canada's Highly Qualified Manpower Resources, 1970

MOSST, Highly Qualified Manpower Post-Censal Survey 1973: Specifications for the General Set of Tabulations, April 1974

III. FUNCTIONAL CHARACTERISTICS

Of the four scientific functions stated earlier (research, regulation, interpretation and management), it is the research function which has, until recently formed the basis for defining Research Scientists (SE-RES). The membership of this group is stated to comprise "scientists, the primary purpose of whose employment is to conduct fundamental or applied research in the biological or physical sciences or (certain areas) of mathematics".[6]

An examination of the Classification and Selection Standard manuals of scientific groups suggest, in functional terms, three types of groupings:

I. where the primary function is to perform scientific research (e.g. SE group).

II. where the primary function may be either scientific interpretation or regulation, though research is still regarded as one of the functions (e.g. BI, PC, CH, FO, MT groups).

III. where due to the interdisciplinary nature of work, and flexible project management program, a wide range of research related functions have been assigned to one group (e.g. DS group).

Scientific Research Group (SE)

The Scientific Research group (SE group) is composed of three sub-groups: the Research Scientist (RES), Research Manager (REM); and the Science Advisor (SCA). Since the current strength of the SCA sub-group is two members, we shall only consider the other two sub-groups, RES and REM with a major emphasis on RES because of its research-intensive functions.

As stated earlier, the primary purpose of employees in the RES sub-group is "to conduct fundamental or applied research". The functions excluded from this group's designated activities are those of "information and extension", "directing scientific programs and research organizations" and other related scientific activities like "analysis", "surveys" and "testing".[7]

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[6] Treasury Board, Classification and Pay Standard-Research Scientist Class, April 1966, p. 2.

[7] Ibid., p. 2

It is only recently that changes have been made in the scope of this sub-group's responsiblities.[8] The new draft standards describe the RES group's major responsibilities as follows:[9]

- "the planning and conduct of R&D studies and projects and the interpretation and communication of results"; and

- "the provision of advice and scientific leadership to others, and of consultative services within or external to the federal government".

In addition, the RES sub-group is in some cases, required to determine the scientific objectives, coordination and control of the conduct of R&D; and evaluate scientific accomplishments, including responsibility for providing authoritative scrutiny on contracted R&D.

It can be seen from the above that in the new classification manual the role and function of the RES sub-group has been substantively modified to include technology-transfer considerations and to provide "scientific leadership". This is to be done in association with the Research Manager Sub-group (REM) whose primary functions include "direct", "coordinate" and "advise" for programmes of research in natural science.

For the SE group, members require a doctorate in a field of the natural sciences or a lesser degree with a number of years of related experience. Research Managers in addition, must show evidence of the administrative skill and knowledge required in the position. Of the SEs (RES & REM) for whom information on education is available, the proportions holding post-graduate degrees are: RESs: Ph.D. 62.6% and, M.A. 11.2%; and REMs: Ph.D. 12% and, M.A. 15%.

<u>Biological Sciences Group (BI)</u>

An examination of the 'classification & selection standard' manual for the BI group shows that in addition to analysis, classification and survey of plants, animals, microorganisms and the management of wildlife and other biological resources, employees of this group may be also engaged in biological research

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[8] Treasury Board and Public Service Commission, <u>Classification and Selection Standard; Scientific Research Group, Scientific and Professional Category</u>, September 1976 (DRAFT).

[9] <u>Ibid</u>, p. 1-3

when they "are not qualified for inclusion in the Scientific Research (SE) group".[10] Whether their function is to support Research Scientists (RES) or to carry out independent research, is not adequately defined in either BI or SE classification manuals.

Although the entrance requirements for this group is B.A. in biological sciences, a recent study showed that a significant number of the population in this group had a Masters degree or above (43.6%). Of this graduate population, 13.9% possessed doctoral degrees.[11]

In terms of functions performed by the group, the study from its survey sample noted that 62% were engaged in research, 11% in quality control, 14% in interpretation and 13% in supervision and management.[12] It was observed that in terms of BI's research function, they were often used as part of a research team where they could look after individual project in a more complex project/programme, often being run by a RES.

Defence Scientific Service Group (DS)

The Defence Scientific Service (DS) group is unique in the sense that whilst engaged in "the conduct of research and development and directly related programs designed to advance defence science and technology"[13], its classification and selection standards manual do not limit DS group's functions to research; and a post-graduate degree (Ph.D. or an equivalent degree) is not a prerequisite for membership within the group.

Positions included in the group are expected to be occupied by persons whose primary duties may not necessarily be limited to scientific research and development but also consist of one or more of the following: scientific analysis, scientific management; or on a rotational basis involvement in scientific advice and liaison, scientific policy and evaluation, and scientific

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10 Treasury Board and Public Service Commission, Classification Standard, Biological Sciences Group, Scientific and Professional Category, November 1971.

11 Manpower Survey Report, Biological Sciences Group, August 1975, Human Resources Planning Division, Public Service Commission, pp. 14

12 Ibid, p. 28-31

13 Treasury Board and Public Service Commission, Classification and Selection Standard, Defence Scientific Service, Scientific and Professional Category, March 1976, p. (iv)

information. However, engineering functions like the application of a proven body of data, principles and practices to the design, construction and operation of equipment, systems or works have been specifically excluded.

A major reason for such DS group orientation is due to the fact that substantive work within the defence research organization, as the group's classification manual asserts, "requires frequent formation and dissolution of multidisciplinary teams of scientists and reassignment of duties in response to changing departmental priorities and objectives. To meet this requirement, the scientists must be given an opportunity to acquire broad experience to function at the full level of their capacity".[14]

Furthermore, a variety of full time liaison advisory and evaluation activities are closely associated with laboratory activities and are manned on a rotational basis by research scientists with relevant knowledge, experience and capabilities. In practice, candidates are chosen for their ability to fill a particular need at a point in time and therefore may move to assignments without automatic change in designation.

In addition, the minimum qualifications to enter the DS group requires only graduation from a recognized university in a discipline relevant to defence science. For instance, the present DS manpower strength within the Defence Research Establishment of the Department of National Defence comprises about one-third Ph.Ds, one-third Masters, and the remaining third with a Bachelors degree in natural sciences or engineering.**

Implications

The foregoing suggests the practice of two basic approaches in scientific personnel management in the Public Service. The first one assumes the Research Scientists (SE) to be the apex group whose raison d'être within the Public Service is to provide "scientific leadership". Implicit in such a role is their superior status relative to other scientific groups. Until now, the relationship between the SE group and other scientific personnel has not been made clear except for differences in their performance appraisal frameworks.

[14] Ibid., pp. iv-v

** See Appendix 'A' for a description of existing classification systems in the National Research Council (NRC) and the Atomic Energy of Canada Limited (AECL).

The second approach is in the explicit multifunctional orientation of the DS group. Positions in this group, unlike SE group, do not make an arbitrary split between various scientific functions. It has no REM-RES type split between research scientist and research managers. In fact, because of frequent formation and dissolution of multidisciplinary teams of scientists in response to changing departmental priorities, the classification calls for involvement on rotational basis.

Although both types in essence are 'person oriented' groups where the individual performance forms the basis of career advancement and mobility, the DS functions are specifically 'task-oriented' to Departmental missions. In the SE group, more emphasis seems to have been on the initiative and creativity of the research scientist.

Another difference in the two approaches is educational requirements. Although the educational background for all the scientific groups has a common scientific base - a degree in natural sciences, in the DS group, educational requirement does not create an entrance or mobility barrier. However, in the case of SE group a doctoral degree is always preferred. A major difference between the SE group and other scientific groups is often stated to be in terms of the former's (SE group's) Ph.D. level backgrounds. Such a division seems artificial as a substantial number of personnel in other scientific groups now have Masters and above level education, and a number of them are involved in the conduct of research. Table III shows (see page 10 a) that a significant number of personnel in other scientific groups have Masters or above level degree, e.g. BI (42%), PC (44%), FO (74%) and MT (30%).

Table - III Educational Backgrounds: Selected Scientific Groups

Groups/ Educational Background	B.A.		M.A.		Ph.D.		Unknown		Total	
BI	257	(31.2%)	233	(28.3%)	116	(14.2%)	216	(26.3%)	822	(100%)
CH	241	(54.3)	87	(19.6)	44	(9.9)	72	(16.2)	444	(100%)
PC	203	(35.3)	172	(30.0)	79	(13.8)	120	(20.9)	574	(100%)
FO	5	(4.3%)	39	(33.3%)	48	(41.0%)	25	(21.4%)	117	(100%)
MT	334	(54.1)	177	(28.9)	7	(1.0)	99	(16.0)	617	(100%)
AG	305	(77.4)	27	(6.8)	3	(0.8)	59	(15.0)	394	(100%)
RES	120	(5.9%)	228	(11.2%)	1267	(62.6%)	410	(20.3%)	2025	(100%)
REM	18	(6.5)	43	(15.4)	34	(12.1)	184	(66.0)	279	(100%)
SRE	279	(77.5%)	20	(5.6%)	4	(1.1%)	57	(15.9%)	360	(100%)

Source: IMC 6576 Listings - Stock Factors By Employee classifications, 13-02-77, Human Resources Planning Division, Public Service Commission.

Government Projects Division
Government Branch
MOSST

April 1977

IV. MOBILITY CHARACTERISTICS**

Mobility of scientific personnel within the Public Service can be viewed on three levels: their movements within and out of a Department; movements within and out of Occupational Groups; and movements from government to industry and universities, and vice versa. A majority of data available on this aspect essentially deals with movements within the Public Service. Little information is available about the movement and exchange of personnel with non-governmental sectors.

Movements into and separation from the Public Service

Table IV

RES SUBGROUP APPOINTMENTS, TYPES 01 AND 81

Year	Type of appointment	RES Level 1	2	3	4	Total
1971	01	64	23	3	0	90
	81	14	35	8	2	59
1972	01	66	31	4	0	101
	81	8	27	6	2	43
1973	01	86	31	5	0	122
	81	16	37	9	3	65
1975	01	61	23	9	0	93
	81	20	48	17	4	89

Source: Data from IMC 1729 Listings, Public Service Commission.

Table IV shows the level by level breakdown of appointments to the RES sub-group from outside the Public Service (Type 01) and terminations of RES Public Service Employment (Type 81) for the years 1971, 1972, 1973 and 1975. The figures demonstrate that the inflow of research scientists into the Public Service until 1973 outweighed their outflow roughly two to one. The 1975 figures show an increase in the number of persons leaving the Public Service and balance between the inflow and outflow.

** A large number of observations in this section support the conclusions made in the special Public Service Commissions report on Scientific Research Group. Public Service Commission, Public Service Manpower Survey: Scientific Research Group, March 1974, Manpower Planning Division.

Table V, providing a display of movements from outside as well as inside the Public Service, shows that in these 4 years a total of 577 scientists joined the sub-group while only 350 left it. The figures also show that most research scientists enter the SE group directly on their original entry into the Public Service. Very few move from other groups to the RES sub-group. In recent years, a trend of RES sub-group members switching to other groups is also becoming noticeable. In 1971, only 8 RES members moved to other groups in the Public Service; in 1975, this number had risen to 42.

Historically, separation rates of research scientists from the Public Service have been very low. Table VI shows (see page 13a) that since 1966, the separation rate of the Scientific Research (SE) group has been under 5.6 percent per annum. In 1974-75, for the SE group (RES and REM), it was 4.2%, the lowest of all the twelve scientific groups in contrast to 11.1% separation rate for the total scientific and Professional Category. This low separation rate has been one inhibiting factor in mobility of personnel within the SE group.

Movements within the Public Service

In an examination of movements 'into and outwards' from RES and REM sub-groups, Table VII (see page 14a) shows that there are movements from SE group to the other scientific groups and vice versa. Of the 49 persons who joined the RES from inside the Public Service in 1975, 48 originated from other scientific groups. Similarly those who left the RES sub-group - out of 68 persons, 61 joined scientific groups. They included 26 individuals who joined the SE sub-group REM.

This Table also shows a similar pattern for REM sub-group. Of the 43 persons joining this group in 1975, 14 were from other scientific groups and 3 from other occupation groups (26 moved from the RES sub-group as shown earlier). Of the 12 persons who moved out of the REM sub-group, 10 joined the SX and two the PM groupings.

Movements from Public Service to Other Sectors and Vice Versa

The conclusions drawn by the Public Service Commission Manpower Survey for Scientific Research (SE) group provides some basis for making valid generalizations in this area.[15] While trying to determine the extra-governmental experience of the RES sub-group, the survey from its random sample of 500 RES members

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[15] Public Service Manpower Survey Scientific Research Group, March 1974, Manpower Planning Division, Public Service Commission, 1974, p. 26.

TABLE V

RES Subgroup Mobility.

YEAR	TYPE OF MOVEMENT	1	2	3	4	TOTALS
1971	UC* → RES	36	8	0	0	44
	G** → RES	6	4	0	0	10
	Type 01	69	23	3	0	90
	Appointments	106	35	3	0	144
	RES → UC	2	2	0	0	4
	RES → G	1	3	0	0	4
	Type 81	14	35	8	2	59
	Separations	17	40	8	2	67
	Net Movement	+89	-5	-5	-2	+77
1972	UC → RES	6	4	0	0	10
	G → RES	13	7	2	0	22
	Type 01	66	31	4	0	101
	Appointments	85	42	6	0	133
	RES → UC	2	0	0	0	2
	RES → G	8	7	1	0	16
	Type 81	8	27	6	2	43
	Separations	18	34	7	2	61
	Net Movement	+67	+8	-1	-2	+72
1973	UC → RES	0	0	0	0	0
	G → RES	27	7	2	0	36
	Type 01	86	31	5	0	122
	Appointments	113	38	7	0	158
	RES → UC	0	0	0	0	0
	RES → G	9	15	2	1	27
	Type 81	16	37	9	3	65
	Separations	25	52	11	4	92
	Net Movement	+88	-14	-4	-4	+66
1975	UC → RES	0	1	0	0	1
	G → RES	25	22	1	0	48
	Type 01	61	23	9	0	93
	Appointments	86	46	10	0	142
	RES → UC	0	0	0	1	1
	RES → G	14	27	0	0	41
	Type 81	20	48	17	4	89
	Separations	34	75	17	5	131
	Net Movement	+52	-29	-7	-5	+11

* Unconverted Classes
** Occupational Groups other than SE

Data from IMC 1729 listings.

Government Projects Division
Government Branch
MOSST

April 1977

found that the distribution of industrial and university experience (exlcuding post doctoral experience) was as follows: only about 10 per cent of the sample were known to have any industrial experience, while less than 4% had worked at universities.

In a comparison of experience distribution of the RES and REM sub-groups, the study found that the most striking feature of the RES and REM extra governmental experience was "their similarity, not their differences". Both the RES and REM population were predominantly speciality oriented and lacked industrial experience.

About 100 employers have been identified outside of Federal Government with whom the President of the Treasury Board or the Minister of Finance has entered into a 'reciprocal transfer agreement'. Although the exchange programs like the "Executive Interchange Program" since 1971, have been gaining in popularity, they have been confined mainly to personnel in the Executive (SX) category.[16] Even where such movements have taken place, it has been found that technically qualified people from the government have moved to management or advisory positions, not to active laboratory ones.

Low Mobility

From the foregoing examination of mobility characteristics of scientific manpower it is evident that the members of scientific occupational groups tend to remain in these groups for long periods, often until their retirement. The separation rate from the Scientific Research group has been significantly lower since

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16 Science Council of Canada, The Movement of Scientific and Engineering Personnel Between the Federal Government and Industry (a commissioned study by Donald Watson), Unpublished, November 1976, pp. 17-19.

Participation of major science based Departments in the "Interchange Canada Program" was as of May 1, 1976 as follows:

	Department	Public Servants Out	Other Sectors In
1.	Agriculture	-	-
2.	Environment	9	6
3.	National Health & Welfare	-	3
4.	Energy Mines & Resources	1	2
	Total Federal Departments	64	139

Table VI Separation in Relation to Strength By Scientific Occupational Groups in the Scientific and Professional Category (1965-66 to 1974-75) *

(in percentages)

Groups	65-66	66-67	67-68	68-69	69-70	72-73	73-74	74-75
Agriculture (AR)	5.9%	6.0%	9.2%	6.0%	8.2%	4.3%	6.7%	5.6%
Biological Sciences (BI)	5.6	12.8	5.1	8.1	4.3	19.9	4.8	5.7
Chemistry (CH)	11.5	10.1	14.3	8.9	4.9	8.8	4.8	4.4
Engineering (EN)	8.3	8.7	8.4	7.2	5.5	6.2	6.8	8.3
Forestry (FO)	8.3	6.9	6.7	5.5	8.9	5.5	3.9	8.7
Medicine (MD)	7.0	13.2	7.8	10.1	13.8	18.3	8.8	9.9
Meteorology (MT)	6.8	5.4	6.9	5.9	5.2	4.2	4.5	5.1
Pharmacy (PH)	7.5	24.5	14.9	15.3	15.4	12.2	7.1	11.6
Physical Sciences (PC)	5.7	4.2	9.2	4.9	5.6	2.2	5.3	4.7
Scientific Regulation (SR)	8.5	7.6	3.9	3.1	5.5	5.8	3.3	5.8
Scientific Research (SE)	-	4.4	4.5	4.3	5.6	2.6	3.1	4.2
Veterinary Science (VS)	6.2	6.2	5.8	4.8	4.4	5.9	8.1	7.7
Total Scientific Professional Category	12.0%	13.2%	10.5%	10.1%	13.5%	11.6%	10.7%	11.1%

* inclusive of retirements

Sources: Treasury Board, "Separations in Relation to Strength 1965 to 70, Public Service of Canada".

Treasury Board, "Separations in Relation to Strength 1972 to 73, Public Service of Canada".

Treasury Board, "Separations in Relation to Strength 1973-74, Public Service of Canada".

Government Projects Division
Government Branch
MOSST
April 1977

1972 when compared with the overall separation rates of other groups within the Scientific and Professional Category. Since 1971 more people have joined the group than have left it.

Although there is some two-way movement between the SE group and other scientific groups, this movement, in spite of a common knowledge-base and similarity in skills and training, has been meagre. More persons move into the Scientific Research group from outside the Public Service than from other scientific groups.

With regards to extragovernmental experience, very few members of scientific groups have acquired university** or industry experience. Moreover, there is no significant exchange between government scientific personnel and other sectors. Members who have moved outside on interchange programs have generally taken managerial or advisory type positions and not laboratory ones. This is mainly because of the nature of the Executive Interchange programs.

** apart from post-doctoral fellowships.

Table-VII: Mobility of Scientific Groups within Public Service.

To / From	BI	CH	ENG	ES	FO	MT	PC	PM	REM	RES	SRE	SX	Other	Total (without movements in the same group in parantheses)
A									1					
BI									2	20				
C									1	5				
ENG									4	3				
F									2	44				
M									-	3				
PC									4	12				
P									1	-				
REM	-	-	-	-	-	-		2	31	-	-	10		43 (12)
RES	8	4	6	4	1	5	10	1	26	309	1	-	2	377 (68)
V									-	1				
Others									2	1				
TOTAL									74 (43)	358 (49)	74			

(without movements within same group in parantheses)

Total RES Population: 2000
Total REM Population: 187

Source: IMC 1729 listing PAF Movements for 1975, 18-03-76 and JMC6577 Listing 1-4-1976. Human Resources Planning Division, Public Service Commission.

Government Projects Division
Government Branch
MOSST

April 1977

V. AGE CHARACTERISTICS

The overall age distributions of the scientific groups show that their present distribution in general is skewed toward youth (26-35 years) whilst at the same time possessing a number of mature scientists. Table VIII provides an age profile of selected scientific groups. The above description fits a majority of these groups. A large number of groups (BI, CH, PC, FO, MT, EN, AG) have sixty per cent of population below age 55; there are only three scientific groups in which more than 55% of the population is above age 45 (REM: 84%; MD: 76%; VS: 57%). RES sub-group has 56 percent of its membership below age 45 and 44 per cent above age 45. The notable exception among the research-based scientific groups is REM sub-group of Scientific Research (SE) group: 84% of REM population comprises individuals of 45 years age or above.** This is understandable because of the requirement for entry to this group is one's experience and capability as a research project leader. A majority of Research Managers (REMs) have been earlier Research Scientists at RES 2 level. Nevertheless such a high proportion of Research Managers above age 45 raises concerns about the use and purpose of the "managerial ladder" as compared with "technical ladder".

The age distribution pattern becomes symmetrical when RES and REM sub-groups are combined and examined as one SE Group. As Tables IX and X show (pages 16 & 16a) when research-based scientific groups are combined together, the age-distribution pattern becomes more symmetrical than age-distribution patterns of individual groups. This implies that scientific groups, together or separately, do not present a staffing problem in the short-term. The group barriers tend to give a fragmented picture of age-distribution related issues. However, the foregoing does not provide us with the long-term implications of such age-distribution in view of the present constraints on growth within the Public Service.

Public Service Growth Constraints and Age Distribution Trends

An examination of changes in the age-distribution pattern over a four-year period (1974 to 1977) for six main research-intensive scientific groups demonstrate that few new young scientists are entering the Public Service. Table X highlights some of the related aspects as follows:

** In 1976, REM composition by levels was noted as follows:
REM I (11%); REM II (46%); REM III (43%)
(Source: IMC 6577 Listing, 1/4/76)

Table VIII: Age Profile of Scientific Groups

Groups	Under 26 years	26-35 years	36-45 years	46-55 years	56-65 years	TOTAL
SE-RES	0	412 (20.4%)	718 (35.6%)	651 (32.2%)	236 (11.8%)	2019 (100%)
SE-REM	0	18 (8.1%)	17 (7.6%)	121 (54.3%)	67 (30.0%)	223 (100%)
BI	46 (5.6%)	426 (52.1%)	173 (21.2%)	119 (14.6%)	53 (6.5%)	817 (100%)
CH	19 (4.3%)	201 (45.6%)	106 (24.0%)	74 (16.8%)	41 (9.3%)	441 (100%)
PC	26 (5.6%)	295 (51.9%)	135 (23.8%)	80 (14.1%)	32 (5.6%)	568 (100%)
FO	6 (5.2%)	35 (30.4%)	39 (34.0%)	26 (22.6%)	9 (7.8%)	115 (100%)
MT	66 (10.7%)	246 (40.0%)	122 (19.8%)	117 (19.0%)	65 (10.5%)	616 (100%)
EN	118 (4.6%)	900 (35.1%)	645 (25.0%)	639 (25.1%)	264 (10.2%)	2576 (100%)
MD	0	34 (8.7%)	58 (14.9%)	174 (44.6%)	124 (31.8%)	390 (100%)
AG	58 (14.8%)	117 (29.7%)	66 (16.8%)	85 (21.6%)	68 (17.1%)	394 (100%)
SG	28 (5.2%)	186 (34.1%)	109 (20.0%)	140 (25.6%)	81 (14.9%)	554 (100%)
VS	12 (2.0%)	128 (21.6%)	114 (19.2%)	177 (29.9%)	162 (27.3%)	593 (100%)
DS	29 (5.9%)	149 (30.1%)	105 (21.3%)	146 (29.7%)	64 (13.0%)	493 (100%)

Source: Group and level Profiles IG3C, 18-01-077, Human Resources Division, Public Service Commission.

Projects Division
Government Branch
MOSST

April, 1977

Table IX: Age Distribution of Research Intensive Groups (1977)

Groups	Under 26 yrs.	26-35 years	36-45 years	46-55 years	56-65 years	Total
SE (RES & REM)	-	430	789	772	303	2294
BI, CH, PC	91	922	416	273	126	1828
FO, MT	72	281	161	143	74	731
Total	163	1633	1366	1188	503	4853
Total %	(3.4)	(33.6)	(28.1)	(24.5)	(10.4)	(100.0%)

(i) Since 1974, the combined manpower strength of the six research intensive groups (SE, BI, CH, PC, MT and FO) has increased by 8.5 per cent.

When these scientific groups are considered invidually, the SE group shows an increase of only 2.6% over the four-year period. FO and MT groups together show a decrease, - 6.16%. Only the groups like BI, CH and PC when combined show an increase of 25% in their membership strength. (See appendix B).

(ii) The most significant decrease is noticeable in the numbers of those under 26 years of age. Their numbers relative to other age-groups are becoming gradually smaller from 5.7% in 1974 to 3.4% in 1977. The overall change for this group, has been a 36.6% decrease over this four-year period.

(iii) The two age-groups which show large increases are: '36-45' years and '56-65' years. These show a 16.7% increase each.

With the Public Service constraints on new recruitments, growth has been anticipated to be 1.5% per annum. The long-term effect of this trend implies that the present majority (26-35 years) population would continue, which could lead to a crisis in the 1990s when the majority of present researchers reach retirement age without adequate replacements. These trends in the within the Public Service are very similar to those forecast for other sectors.[17]

[17] Data Base Relevant to Age Distribution of the Scientific Research Personnel, Task Force on Research in Canada, Science Council of Canada, September 1976. Unpublished paper.

Table X: TRENDS IN AGE-DISTRIBUTION OF RESEARCH-INTENSIVE SCIENTIFIC GROUPS (SE, BI, CH, PC, FO and MT)

	1974 No.	%	1975 No.	%	1976 No.	%	1977 No.	%	Increase / Decrease Since 1974 ** %
Under 26 years	257	5.7	243	5.3	202	4.3	163	3.4	- 36.6%
26-35	1494	33.3	1540	33.5	1605	34.1	1633	33.6	9.0%
35-45	1170	26.2	1230	26.8	1279	27.2	1366	28.1	16.7%
46-55	1125	25.2	1146	25.0	1181	25.1	1188	24.5	5.6%
46-65	431	9.6	436	9.4	438	9.3	503	10.4	16.7%
Unknown	-	-	1	0.02	3	0.06	5	0.1	
Total	4477	100.0%	4596	100.0%	4708	100.0%	4858	100.0%	8.5%

** No reliable data available prior to 1974.

Source: Compiled from IMC 1729 Listings (1974, 1975, 1976 and 1977), Human Resources Planning Division, Public Service Commission.

Projects Division,
Government Branch
MOSST

April, 1977

It is too early to gauge the impact of Public Service growth constraints on scientific manpower. At present, in terms of unused man-years, the present vacancy rate in general is approximately 6%.[18] However, in the first two to three years of the constraint period, the tendency will be to bring manpower strengths more closely in line with available man-years. This is in fact already taking place. A majority of the Departments are filling their unused man-years. However, over a longer period, as numbers become more and more constricted, there are two possibilities.

First, as workloads increase but the number of positions do not, pressure will increase to up-grade the level of positions. The problem may not be acute for performance oriented groups like SE or DS; but it could be worse in the case of 'position-oriented' scientific groups. Second, as vacancies become more scarce, competitions (and appeals) will also become more stringent, forcing the appointment of high talent employees only.

Another long-term problem which requires more serious consideration is matching the demands of Departments (in view of new priorities) with talents and skills available over a 10 to 20 year period. Some departments have from time to time indicated a dearth of talent in particular areas (e.g. taxonomy and conservation). The Public Service Commission and the Treasury Board Secretariat in the past few years have been asked to support courses in Canadian universities and colleges in some of these areas. However, no long-range planning has been done to match the needs and demands of departments with skills and talents available in the university and industry sectors.

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18 Human Resources Planning Division, Public Service Commission, <u>Policy Implications on Growth and the Consequent Impact on E.O.W. and Part II of the Official Languages Resolution</u>, unpublished paper.

VI. SALARY CHARACTERISTICS

The salary data for occupational groups would help in pointing out two aspects: (a) relationship of the rates of pay to the qualification for joining a position; and (b) relationship of rates of pay to the job specifications and work performed. The discussion of salary characteristics here does not include issues pertaining to collective bargaining.

Table XI shows "Minimum-Maximum Pay" and "Classification Level Range" for selected scientific groups. The 'Minimum Pay' reflects the recruitment level salary for a person who fulfils minimum requirements to enter a group. It is generally based on educational requirements for a position, and is comparable to what is being paid by other sectors to attract university graduates with B.A., M.A. or Ph.D degrees.

Educational Qualifications

In the Public Service, those scientific groups which have an educational requirement at the Bachelors level in natural sciences include Biological Sciences (BI), Chemistry (CH), Physical Scientist (PC), Meteorologist (MT), Scientific Regulation (SG). The minimum salary for these groups ranges between $8,280-$9,790 (in 1975). Some major exceptions are groups like Engineers (EN), Pharmacy (PH) and Medicine (MD) which, because of the demand for their special training and skills, have traditionally higher pay rates outside the Public Service. The recruitment salary for Scientific Research (SE) group is higher mainly because of its requirement to recruit persons with either Ph.D. level education or extensive research experience.

The 'Maximum Pay', on the other hand, has been set to correspond with the Executive (SX) category salary scales which represent the senior managerial levels in the Public Service. Again exceptions to the Maximum Pay levels are groups like Medicine (MD) or Research Scientist (RES 4). Their maximum salary scales correspond with the SX category.

Levels and Performance Appraisal

With regards to the range of levels of these occupational groups, indicating complexities of tasks performed, most of the groups which require a Bachelors degree, have a range of 1 to 6 levels. In some of these groups, especially the research-intensive groups like BI, CH, PC, those with the post-graduate qualifications (M.A. and Ph.D.) may be recruited at higher levels, equivalent to RES 1.

Table XI: Salary Scales of Selected Scientific Groups

Groups	Classification Level Range	Minimum-Maximum Pay	Effective Date of Agreement
BI	1 to 6	$8,280 to $36,500	1.4.75
CH	1 to 6	$9,240 to 36,500	1.4.75
PC	1 to 6	8,668 to 36,500	1.4.75
FO	1 to 5	9,300 to 36,500	1.4.75
MT	1 to 9	8,360 to 36,500	1.4.75
SE-RES	1 to 4	$12,980 to $40,550	30.6.75
SE-REM	1 to 3	20,940 to 37,200	30.6.75
DS	1 to 6	$11,338 to $37,300	
EN-ENG	1 to 8	$13,110 to $41,500	1.4.75
EN-SUR	1 to 8	9,790 to 41,500	1.4.75
MD-MOF	1 to 5	22,790 to 47,500	30.6.75
MD-MSP	1 to 2	29,300 to 44,900	30.6.75
MD-MSP	3	33,500 to 47,500	1.4.75

Source: PMM Pay Schedules for "Scientific and Professional Category".

* National Research Council (NRC) has a single group system of RESEARCH OFFICERS, 1 to 5 levels, $10,750 - $36,595 minimum-maximum salary-scale (July 1975-76 interim agreement).

Government Projects Division
Government Branch
MOSST

April 1977

If one relates salary groups and levels to the work performed, a major difference between the Scientific Research (SE) subgroups and other scientific groups is that the former is "person oriented" while the latter "position oriented". In the position oriented jobs, career progression is essentially based upon standard annual increments while in the person oriented jobs, the emphasis is on relating an individual's pay to an assessed level of performance.

The description of Research Scientist (RES), classification level 1, requires "the normal recruiting and learning level for inexperienced scientists". For RES level 2, the classification seeks "experienced scientists who are directed to achieve scientific objectives". Level 3 goes on further to demand "demonstrated mastery" from the experienced scientists in their fields of specialization.

Research Scientists automatically move from levels 1 to 2 after putting in a minimum number of years of service. For RES 2 to 4 levels, a person-oriented performance pay-plan has been in operation since July 1974 which relates employees' salary increases to the assessed levels of performance.

The performance pay plan system is only 3 years old and its impact on Scientific Research groups work is still too early to gauge. Presently, as a result of the performance plan, one notices an accumulation of research scientists at the RES 2 level. See Table XII for a level profile of RES sub-group.

Table XII: Level and population Profile of RES sub-group

Time in Level	RES I	RES II	RES III	RES IV	Total
More than 5 years	29	686	108	38	861
More than 10 years	3	251	23	4	281
Total RES Population	333	1223	336	78	2000

Source: Compiled from IMC 6577 Listings, Human Resources Planning Division, Public Service Commission. 1-4-76.

Summarizing, the salary and level characteristics of scientific groups suggest that a majority of scientific groups have a similar range of task-complexity. The RES sub-group may appear to be a research group par excellence, however this factor becomes vital only after RES 2 levels. Up to RES 2, there does not appear to be significant difference in the anticipated research functions of this group and the other scientific groups. At the higher levels (e.g., BI4, BI5 and BI6), such distinction between the Scientific Research group and other scientific groups becomes fuzzier.

Secondly, in spite of the 'position' and 'person' orientation difference between the job classification of Scientific Research (SE) group and the other groups, no strong rationale has been developed to show why most of the other groups performing research-intensive functions are not appraised on performance basis. The pay system generally for all groups should be a skillful blend of 'person' and 'position' career development systems. Another question raised by this data is: whether the supposedly support function provided by professional scientific groups to the SE group, should not be provided to them by personnel from the Technical and Engineering Support category.

VII. SUMMARY AND CONCLUSIONS

The foregoing examination of the main characteristics of scientific occupational groups shows the practice of two basic approaches to scientific personnel management in the Public Service.

Two Approaches to Scientific Personnel Management

The first one assumes the Scientific Research (SE) group to be the apex group whose major purpose within the Public Service is to provide "scientific leadership". Implicit in such a role is their superior status relative to other research intensive scientific groups. See Figure-1. The Scientific Research (SE) group, as shown in this figure, is on the top layer, representing the most research intensive scientific

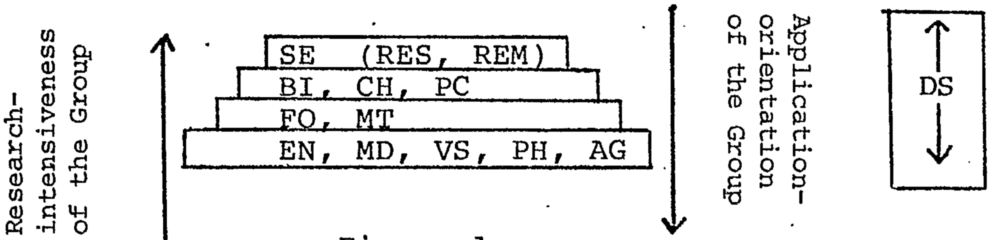

Figure-1

group in the Public Service; whilst the groups at the bottom layer (Engineering (EN), Medicine (MD) etc.) are least research intensive. Research in this case only fulfils a peripheral function.

The groups between the most and least research intensive are those which are engaged in a range of research related scientific functions or research itself. The Scientific Research (SE) group has tended to be a role-model in setting unwritten standards on the desirable quality of research performed by other groups.

The second approach to scientific personnel management is that of Defence Scientific Services (DS) group wherein there are no distinctions between those in scientific research activity and others. Positions in the DS group are multifunctional and rotational and no arbitrary split is made in the functions performed by professional scientific personnel. For example, unlike the SE group, the DS group has no REM-RES type split between research scientists and research managers. In fact, as the DS classification manual asserts, frequent formation and dissolution of projects in defence research organizations call for flexibility and adaptability in performance by members of the group. Should such flexibility and adaptability not be the norm in other federal research organizations?

In view of new departmental missions and changing governmental priorities (e.g. oceans, energy, environment and conservation of natural resources) all federal research organizations need to be adaptable. For this, suitable personnel would need both a broad knowledge-base as well as the desired speciality. Until recently, public service classification has emphasized the recruitment of specialists from narrow scientific disciplines than of persons with broad interdisciplinary backgrounds. The classification standards manuals are in themselves a reflection of the basis on which disciplines have been traditionally organized in academic institutions. They do not take into consideration the new developments which have even taken place in these institutions in terms of more open interaction between various faculties. The developments have stimulated multi-disciplinary research in the universities and are promoting researchers with a broad background.

A recent revision of the classification manual of scientific groups has been made by the Treasury Board Secretariat to update standards for the SE group. However, this appears to be a singular effort. The revised manual, though in keeping with the Treasury Board's emphasis on relevance and productivity of research programs, has developed the SE's standards in isolation from other scientific groups. The other scientific groups continue to perpetuate their rigid discipline-bias and an inward looking orientation without any concern for the new thrusts emerging within and outside the Public Service. At least seven of the 13 scientific groups identified in this report require a major revision in their selection and classification standards.

It is thus important that Treasury Board Secretariat in conjunction with science-intensive departments, Public Service Commission and MOSST should seek to rationalise the selection and classification standards of scientific groups not individually but in a concerted manner. Common elements in existing scientific groups should be stressed especially those relating to scientific functions, performance task-complexity, educational backgrounds and common salary-levels.** Our examination reveals that common characteristics among these scientific groups exist which might permit their consolidation into fewer groups and even into a single group like the Defence Scientific Services (DS).*** This would facilitate

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** See Appendix 'C'

*** The National Research Council has a single group system - Research Officer (RO) - which does not distinguish between scientists and engineer, or research scientists and another scientist. However, it has a RCO Group (Research Council Officers) whose members are involved in policy research activities. Atomic Energy of Canada Ltd. (AECL), on the desirable flexibility and exchanges among those performing scientific functions within the Public Service. In addition, the classification systems of the various scientific groups merit careful attention to assess whether they provide adequate career paths for Public Service Scientists in view of new types of missions and priorities imposed upon them. Further discussion of the issue will be done in the subsequent commentary on mobility and ageing aspects.

Reward Structures and Mobility

One of the main conclusions which emerges from our examination of the mobility characteristics of scientific groups is that the members of the SE groups are not very mobile. They tend to remain in their respective groups, for long periods, often until retirement. Even those who move, most often go to other scientific groups.

The mobility issue is a complex one and, often a symptom of broader research management problems such as: the need for a suitable reward structure, a well-designed career path and appraisal system, and an open decision-making organization. Our examination has shown us that there are inconsistencies in the reward structures of scientific groups within the Public Service in terms of their lack of relationship with governmental priorities, departmental mission and goals. Only two of the scientific groups, DS and SE groups, have a 'person-oriented' performance appraisal system while the other groups still continue with a 'position-oriented' appraisal system.** The problem is further complicated for the research manager whose concern is to find an appropriate balance between the quality of research and its applicability (productivity) and relevance to both the user and

***(cont'd) other hand, has two groupings of professionals - Research Officers and Engineers. The separation of the two is not because of salary differences but performance appraisal mechanisms. There are however no differences between research scientists and other scientists as in the Public Service. See Appendix 'A' for personnel management notes on both the National Research Council and Atomic Energy of Canada Limited.

** In the 'position-oriented' jobs, the career progression is essentially based upon standard annual increment which are tied to ones overall satisfactory performance. In the person oriented jobs, the emphasis is on relating an individual's pay to his performance on a particular program e.g. using number of project related publications as a criterion for performance assessment). A desirable system for all scientific groups would be one which skillfully blends both orientations.

to the mission of the laboratory. He must apply two different sets of criteria to appraise the output of an SE group member and a professional scientist from another group working on the same project.

The above discussion of the reward structure is limited to an appraisal of an individual's capabilities to move upward in his own field in a research organization. The existing performance appraisal schemes do not adequately take into consideration benefits derived from a person's movement from scientific to management positions within the research organization; the movement of scientists from one Department to another Department; or their exchange with sectors outside the Public Service.

A 'dual-ladder' type of mobility mechanism is already in operation in the Public Service. A dual-ladder refers here to a mechanism whereby a consistency is attempted between the goals and mission of the organization and professional excellence so that both command equal respect[19]. This is done by creating a dual hierarchy providing promotion prospects on a 'technical/scientific ladder' supposedly of equal status to a parallel 'management ladder' (e.g. RES and REM). However, a number of problems have arisen on account of such dual hierarchy:

(a) There is difficulty in defining the role of positions on the technical ladder;

(b) The technical and managerial ladders may be used as a reward rather than opportunity;

(c) The laddersmay become a shelf for senior staff, found lacking either scientific or managerial abilities; and

Matrix organization which has grown in popularity in recent years might achieve more successfully many of the same objectives as dual hierarchy. While combining the skills of project manager, discipline head, and individual R&D worker under a R&D Director, this multidisciplinary project management approach has helped to broaden the knowledge base and experience of the participants, thus providing them more avenues for movement.

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[19] Brian Twiss, Managing Technical Innovation, London: Longman Group Ltd., 1974, pp. 204-230.

Major science intensive departments in conjunction with the Treasury Board Secretariat and MOSST should examine both the new systems for appraisal of scientists as well as the appropriateness of organizational structures for providing mobility opportunities. This examination should include a consideration of a more rationalized "dual ladder" mechanism which will include all the scientific groups. It should seek to define the role of positions on the technical ladder combining the three essential elements of good research: its quality, relevance and usefulness. The usage of two ladders for providing opportunities to the right sorts of talents - scientific and managerial; and the means of encouraging early selection of those with managerial skills.

Opportunities and incentives should be developed to encourage scientists to rotate between 'scientific, and 'managerial' positions for short tenure both within and outside the Public Service. Consideration should be given to extend the current interchange programs with sectors outside the Public Service to include bench level scientists and research managers. A specific program oriented to exchange of scientific personnel will have a greater impact.

Age-Distribution of Scientific Personnel

Concern about the age-distribution of scientific personnel within the Public Service has arisen because of two factors. Firstly, a massive retirement at a particular time, may leave federal research organizations with a replacement problem. Secondly, enough expertise may not be available within the organization to fill the void left by those retiring from the federal service.

In the short-term, as shown in the section on age-characteristics, the overall age distribution of scientists within the Public Service is fairly proportional, presently, it is skewed toward the 26-35 year-old, while at the same time possessing a number of mature scientists. One may still find problems of replacement at the departmental level, especially in some areas of expertise. The problem, however, is entirely different when viewed in the long-term, over a 20 years period. The impact of present constraints on federal scientific manpower suggests that if the present growth trend continues over this period (to 1995), the proportion of younger scientists would decline, while that of higher-age, who now comprise the 26-35 year bulge, would increase.

For the longer term, if the present trend of constrained growth continues, there may not be adequate replacements when the present 26-35 year old group retires. Furthermore, in a minimum growth situation, the small influx of fresh ideas could lead to intellectual stagnation within the research organizations, thus affecting both their creativity and subsequent productivity. The problem requires further detailed examination because the impact of age-distribution is far-reaching, and with existing systems of occupational grouping, the problem may vary from department to department.

Consideration should be given to initiating a feasibility study in conjunction with science-intensive Departments and to assess statistical dimensions of the ageing problem in view of different scenarios for future growth of the Public Service. In addition, in association with the Treasury Board Secretariat, Public Service Commission and major science intensive departments a study should be made of innovative mechanisms which would facilitate a healthier age-distribution of scientific personnel in the Public Service. The latter study would include consideration of:

- a program of post-doctoral fellowship/research associate fellowships on a tenure basis for federal laboratories to overcome shortages of younger scientists, similar to that currently in operation at the National Research Council;

- the creation of opportunities for federal scientists to diversify their talents and skills, and the development of mechanisms for temporary and permanent transfers outside Public Service (e.g. industry, universities, provinces and outside Canada);**

- the introduction of voluntary early retirement schemes whereby a civil servant could choose to pursue a second career and continue to pay into the retirement fund of the Public Service without forefeiting full benefits later on.

** MOSST has successfully dealt in the development of such transfer mechanisms viz. a viz. industry and universities through 'Make or Buy' Policy and the Granting Council legislation. However, very little attention has been paid to any serious study of possible opportunities for the growth of science (and the subsequent redeployment of federal scientific manpower) at both provincial government and international levels.

Need for Management Innovations

A major assumption of this report has been that the scientific manpower problems are not necessarily the result of individual obsolescence; organizational obsolescence may also play a role.[20] A primary requisite for effective functioning of an organization is a reasonably clear enunciation of the employer's expectations, and the rewards offered to fulfil them. The nature of demands imposed on the organization sets the goals and motivations of individuals working within it.

Over the past decade, there has been a continual shift in the nature of these expectations. Until recently, as reflected by the job-specifications and classification standards, the emphasis was on producing "quality" research, revered by peers and acceptable for publication in academic journals. Since the late sixties, it has been gradually emphasised that in addition to 'quality'; judgement about one's performance should also be based on the relevance of research. Such a shift in emphasis has not so far made any significant impact at the laboratory level because rigid decision-making structures generally exist in government scientific organizations. The isolation of scientists from planning and program development activities in research laboratories may be a factor in lack of appreciation on the part of bench level scientists of the problems facing their research managers.

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20 Paul H. Thompson and Gene W. Dalton, "Are R&D Organizations Obsolete?" Harvard Business Review, November-December, 1976 pp. 105-114.

Although there is a good ratio of Research Manager (REM) to Research Scientists (RES), 1 REM for 9 RES, research managers have not always been successful in translating government priorities or departmental goals to laboratory missions. Instead they have tended to act as a 'shield' between their laboratory personnel and headquarters.** Such protective attitudes may be beneficial in the maintenance of morale in the short- term, but often lead to a situation where researchers are asked to comment on their redeployment to a new subject-area long after the final decision concerning their future has been made elsewhere. Similar problems are encountered when scientists are asked to get involved in technology at the completion of a project. This involvement would be beneficial at earlier stages, eg. project planning or development.

** A Department of Environment Science policy study (1972) which analyses the orientation of its scientific personnel to the Departmental goals and objectives, from a sample of its 553 professionals found that 84 per cent of non-managerial professionals wanted scientists "to have a larger role to play in policy formulation", while only 64 per cent of the research managers agreed to such wider participation. Such differences were also noticed in research manager's reluctance to multi-disciplinary project management teams. In spite of their experience with interdisciplinary groups, only 50 percent of research managers showed any enthusiasm about such approach. (pp.15-19).

On the subject of providing a strong link between scientists and managers, the report concluded,

"Generally, it appears that professionals in DOE feel the need for greater communication in one way or another between managers and scientists. A significant number suggest that such change would require administrative changes." (p. 38)

Science in a Changing Environment Part 2: Interpretation of Science Policy Questionnaire, Science Policy Branch, Department of Environment, Ottawa, October 1972.

A great deal has been written about the correlationship of the 'open' nature of research organization and improved research performance in industrial and university sectors.[21] Major science intensive departments should undertake reviews of the management structures at the laboratory level in order to widen the knowledge-base and improve bench-level scientists' participation in decision-making. A suggestion for introducing mechanisms like "rotational" or "limited tenure" positions possibly at the assistant director levels has been made earlier. A great deal is still required to involve researchers in such relevant areas as project definition, portfolio planning, project control, and resource allocation and general management. Serious consideration should be given to the appropriateness of organizational structure, especially to examine whether the lab should be organized by scientific discipline or by an interdisciplinary management system. Improved awareness in this area has also been attempted through introduction of courses on research and development management. The Public Service Commission, for the past 2 years has been offering a course entitled, "Management Development for Research Managers". Consideration should be given to assess the usefulness of its content and the impact it had on those working at the laboratory level.

[21] Proceedings of 29th National Conference on the Advancement of Research (NCAR) September 14-17, 1975, University of Denver, 1976.

APPENDICES

I. NATIONAL RESEARCH COUNCIL (NRC)

NRC as a 'separate' employer has two main groupings for professional scientific employees: (a) Research Officer (RO); (b) Research Council Officer (RCO).

Research Officer (RO)

RO is the largest group within NRC, comprising scientists and engineers involved in research and development activities. In January 1977, ROs constituted 25 per cent (754 ROs) of the total manpower. Minimum entrance requirements in terms of educational background for the group is a Bachelors degree. 63 per cent of ROs have a Ph.D. while the remaining 37 per cent possess a Masters or Bachelors degree (1975 figures). Both scientists and engineers are included in the RO group.

There are five levels in the RO group. These are: Principal Research Officer (PRO), Senior Research Officer (SRO), Associate Research Officer (ARO), Assistant Scientific Research Officer (ASRO) and Junior Scientifc Research Officer (JSRO). Their salary levels approximate those of the Research Scientists (RES) group in the Public Service. For July 1975-76, they ranged between $10,750 to 36,595 (interim pay scales).

RO Group	Minimum - Maximum Pay
PRO	$33,755 to $36,595
SRO	27,480 to 32,835
ARO	22,100 to 26,900
ASRO	15,025 to 21,550
JSRO	10,750 to 14,750

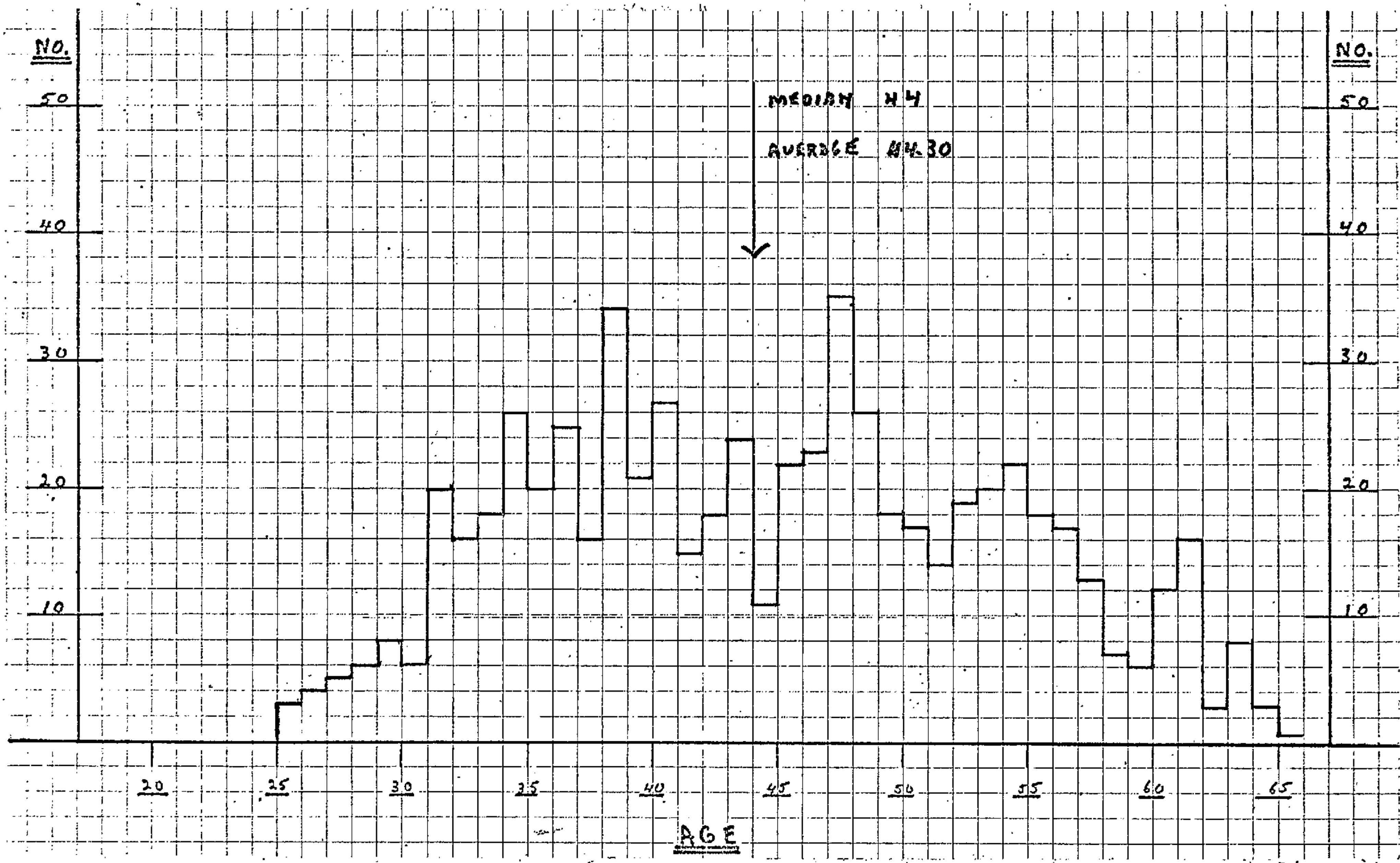
(Both Director and Assistant Directors of Divisions in NRC fall under a different group which is similar to Public Service's Executive Category (SX), Assistant Director's Salary range: $33,700 to $37,000 and Director's: $37,300 to $43,000).

Research Council Officers

Compared to ROs, the Research Council Officers (RCO) are engaged more in policy research type of activities. Although there are different criteria applied for appraising RCOs, their salary scales and levels are the same as the Research Officers.

Figure-C1

RESEARCH OFFICERS - APRIL/76 (643)



Research Associates

In addition to the two above groups NRC employs on a term basis, scientific personnel under its Research Associate Program (a modification of earlier Post-Doctoral Fellowship (PDF) Program). The Research Associateship is no longer restricted to Ph.Ds like in the earlier PDF program. The associate's term is renewable up to five years. Age limit for applying to this program is 36 years. It is hoped that this new program will attract a broader segment of university science and engineering graduates interested in research. In addition, unlike before, the activitites of research associates will be tied to specific objectives of programs being carried out in various division.

Age Distribution

The Council has expressed concern for its professionals' age-distribution. In April 1976, average age of NRC research officer (RO) was stated to be 44.3 years (median 44.0 years) compared with 35 years average age in 1953** See Figure Cl. Like the Public Service, the total number of researchers since 1970 have not increased significantly in NRC. About three-quarters of 24 Principal Research Officers are near retirement age, it is felt that these retirements would help to deflate a bulge at that level, and help in reducing the average age. Moreover, retirements do not necessarily always mean loss of expertise. In fact, they could provide flexibility in reorienting existing programs.

For longer-term purposes, it is felt that with the present no-growth trend, the new research associate program will bring younger people with fresh ideas from the university sector and elsewhere.

Mobility

The upward mobility in NRC is tied to one's performance and aptitude. There are no barriers for transfers between the RO and RCO groups. Both groups have the same five levels and salary ranges. Most of the Section Heads however continue to be mainly from Research Officers group.

To be a Director in NRC, one must excel in his scientific field, as a researcher and project leader. Two general criteria for Director's selection are: scientific leadership and recognized managerial skills.

** Proceedings of the Special Committee of the Senate on SCience policy Issue No. 14, June 9, 1976; 14:37.

Table C-1

SEPARATIONS - NATIONAL RESEARCH COUNCIL

(Excl. PDFs & CB)

YEAR	% of Staff by Category				% of Total Staff	Total Staff (Aver.)	No. of Separations	Reasons for Separations								
								To Work In								
	Sci.	Tech.	Admin. Serv.	Oper.				Indus.	Univer.	Gov't.	Retirements	Death	Family	Study	Health	* Other
1959-60	6.0	7.7	12.7	5.5	8.3	2269	188	43	10	20	9	5	45	22	3	31
1960-61	5.8	7.5	14.8	3.4	8.4	2344	197	45	6	11	9	8	58	22	6	32
1961-62	5.0	6.0	15.2	4.5	7.8	2431	191	23	10	12	14	8	57	29	9	29
1962-63	5.2	7.6	14.2	3.2	8.1	2406	195	36	8	10	8	10	57	33	2	31
1963-64	4.7	5.8	17.1	4.8	8.1	2387	194	32	7	16	7	11	40	32	6	43
1964-65	5.1	5.7	21.7	5.2	9.4	2448	229	40	14	30	15	5	44	26	7	48
1965-66	6.6	7.5	24.0	4.0	10.9	2555	279	52	18	38	14	10	47	34	4	62
1966-67	4.7	6.3	14.6	6.8	8.0	2685	217	36	12	40	13	5	34	26	5	46
1967-68	5.5	6.0	15.6	5.6	8.4	2808	235	37	22	45	30	9	42	33	4	13
1968-69	4.7	5.1	17.1	5.8	7.9	2839	223	24	31	19	19	13	42	33	2	40
1969-70	6.8	5.3	12.6	1.3	6.9	2763	191	22	23	23	27	7	28	25	11	25
1970-71	4.8	4.2	13.7	6.6	6.8	2722	184	16	15	30	26	5	35	15	6	36
1971-72	4.4	4.4	12.4	7.5	6.6	2749	181	28	10	20	31	6	28	10	13	35
1972-73	4.0	4.0	15.7	5.6	7.0	2764	193	30		26	30	4	19	12	19	53
1973-74	5.5	5.5	15.4	12.8	8.7	2788	243	58		27	55	11	15	18	15	44
1974-75	5.2	4.6	15.8	14.1	8.6	2853	246	48		38	49	5	18	17	7	64

*Other Includes: Leaving city, seeking other employment, personal reasons.

With regards to lateral movement of personnel from NRC to other sectors or vice versa such moves have been minimal. Like the Public Service, most people who join NRC tend to remain in NRC for longr periods, often until their retirement. The expertise at the higher RO levels has been recruited from outside only if no one is available within the Council.

Over the past five years, the separation rate for scientific personnel in NRC has been between 4 to 5.5 per cent as compared to general 8.7 per cent separation rate for the Council. Data is not available on the reasons for leaving the Council. Their departure could be due to any of the following reasons: to work in industry, university, government; or due to retirement, death, family, study, health, etc. See Table C1.

II. ATOMIC ENERGY OF CANADA LIMITED (AECL)

Research Officers and Engineers

AECL was created in 1952 as a Crown company independent from the National Research Council. In April 1977, it employed 1101 professional scientific employees. The employees for classification purposes, belong to two occupational groups: (i) Research Officer and (ii) Engineer.

The entrance educational requirement for both of the groups demand a minimum Bachelors degree in engineering or natural science. However, in research oriented groupings like Research Officer, a majority of individuals have a doctoral degree. Similarly in the Engineering Group, of those who work in research (and not construction, site development etc.), a majority have Ph.Ds. See Table C2 below.

Table C2: Educational Background of Scientific Groups

	Ph.D.	M.A.	B.A.	Total
Research Officer	144	12	16	172
Engineering (research)	106	103	314	523
Engineering (construction) etc.	45	105	256	406
TOTAL				1101

In addition, both the Research Officer and Engineering groups have closely related pay and classification level structures. Both the Junior Research Officer (JRO) and Engineer (G-1) have a similar starting salary of $12,500. At the top end, both the Principal Research Officer (PRO) and Engineer (G-8) have a maximum pay range of $34,800 to $40,600.

Age characteristics

The average age of Research Officer is 43.8 years whilst that of Engineers, 42 years. A majority of professional staff, especially engineers, before joining AECL have worked in the industry sector. In a recent submission to the Senate Committee, AECL stated that more than 76% of its professionals had outside work experience before joining the AECL.**

Separation Rate

A record of staff turnover for the past three years shows a very low separation rate for the Research Officer group. This compounded with limits on hiring and budgets, may create aging problems within the AECL in future. For the extent of separation of the two groups from the AECL, see Table C3 below.

Table C3: Separation Rate of Professional Scientific Groups

Separation Rate

	Total	Number left AECL
Research Officers		
1974	174	3 (1.7%)
1975	175	7 (4%)
1976	172	1 (0.6%)
Engineers		
1974	644	42 (6.5%)
1975	650	33 (5.1%)
1976	523	21 (4%)

** Proceedings of the Special Committee of the Senate on SCIENCE Policy, Issue No. 17, Aug. 11, 1976, 17:74, appendix 10

AGE-PROFILES OF SCIENTIFIC GROUPS

Appendix 'B'

RE -RES

Age group \ Year	1974 No.	1974 %	1975 No.	1975 %	1976 No.	1976 %	1977 No.	1977 %
<26	3	0.1	0	0.0	1	0.0	0	0.0
26-35	532	23.8	519	23.0	474	21.0	430	18.7
36-45	732	32.7	731	32.4	756	33.4	789	34.4
46-55	726	32.5	758	33.6	777	34.3	772	33.6
56-65	244	10.9	248	11.0	255	11.3	303	13.2
UNK.	0	0.0	0	0.0	1	0.0	2	0.1
Total	2237	100.0	2256	100.0	2264	100.0	2296	100.0

1974-77 growth: (2.6%)

FO MT

Age group \ Year	1974 No.	1974 %	1975 No.	1975 %	1976 No.	1976 %	1977 No.	1977 %
<26	114	14.6	105	14.0	86	11.7	72	9.8
26-35	283	36.3	272	36.4	287	39.0	281	38.4
36-45	149	19.1	154	20.6	151	20.5	161	22.0
46-55	156	20.0	148	19.8	148	20.1	143	19.6
56-65	78	10.0	69	9.2	64	8.7	74	10.1
UNK.	0	0.0	0	0.0	0	0.0	1	0.1
Total	780	100.0	748	100.0	736	100.0	732	100.0

1974-1977 growth: (-6.16%)

BI - CH - C

Age group \ Year	1974 No.	1974 %	1975 No.	1975 %	1976 No.	1976 %	1977 No.	1977 %
<26	140	9.6	138	8.7	114	6.7	91	5.0
26-35	679	46.5	749	47.0	844	49.4	922	50.4
36-45	289	19.8	345	21.6	372	21.8	416	22.7
46-55	243	16.6	240	15.1	256	15.0	273	14.9
56-65	109	7.5	119	7.5	119	6.9	126	6.9
UNK.	0	0.0	1	0.1	3	0.2	2	0.1
Total	1460	100.0	1592	100.0	1708	100.0	1830	100.0

1974-77 growth: (25.34 %)

Source: IMC 1729 (1974, 1975, 1976, 1977), Human Resources Planning Division, Public Service Commission.

Describing the basic ingredients required for a good 'technology-transfer type' scientific personnel, a large industrial Canadian Company recently pointed out that it looked for following sets of qualifications:

a) A Bachelor's degree in the appropriate discipline(s) is adequate basic education, and where necessary can be supplemented by appropriate courses. Present Master's and Doctorate degree courses are not seen necessary.

b) "Technology Transfer" types often enjoy Business Administration studies which broaden their perspectives.

c) Good "technology transfer types" have a strong element of salesmanship and this is good. Also, when they communicate their work orally or on paper, they usually try to "express" rather than "impress".

d) Although they have more than their fair share of scientific curiousity about why things are the way they are, their scientific curiousity is the servant to getting an objective achieved rather than their master.

e) Good "technology transfer types" enjoy leaving their laboratories and discussing their own and other people's (i.e. sales, purchasing, production, accounts personnel) problems to mutual advantage. They recognize that a useful research project has three broad phases:

   1. Identifying that some research is required to achieve a practical objective and defining the nature of the research.

   2. Carrying out the research.

   3. Applying the research, i.e. achieving the "technology transfer".

   They also appreciate that (1) and (3) can be as difficult, challenging and exciting as (2).

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