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The Distribution of NSERC Funds, and Citation Patterns: 1988-89

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The Distribution of NSERC Funds, and Citation Patterns: 1988-89

From a Grantee *
* *Author's identity withheld upon request*

Introduction

This year, my analysis of the distribution of NSERC grants is more exhaustive than in previous years. Stimulated by the statement from NSERC (form 126) that "citation data can be informative and useful", I have included an analysis of citation patterns, and an analysis of how money is distributed by subdiscipline within Geology. In view of John England's (1989, p. 252) recent suggestion that counting citations is "infantile", I will remain even more anonymous than usual!

There are now three more or less compatible data sets that allow this analysis. The first is the list of NSERC Operating Grants issued annually by NSERC (1989). The second is the American Geological Institute's *Directory of Geoscience Departments, United States and Canada* which lists faculty, with their year of PhD and coded specialty within geology. The third is the *Science Citation Index 1988* (Institute for Scientific Information, Inc., 1989).

There are many interesting implications in this data analysis; I will largely (but not absolutely) refrain from any "editorial comment", and will look forward to reading other comments in the Pyroclasts column.

Because most Canadian geoscientists rely on Operating Grants from NSERC for at least part of their research support, it can be argued that NSERC Operating Grants form an effective way of comparing the research funding levels of (1) geoscience departments across Canada, and (2) subdisciplines within geoscience. Such a survey clearly cannot be extended to research scientists in government laboratories, or in the private sector.

Definitions and Explanations

Total Geology and Geophysics (GG Core) Faculty includes all Assistant, Associate and Full Professors listed in the AGI *Directory*, plus those listed as "on leave". Faculty with Adjunct, Emeritus, *etc.*, status are **not** included. Some of the GG Core faculty are Grantees, some are not. Total NSERC recipients includes all who receive grants from Committee 10 — geologists, geophysicists, geographers, oceanographers, biologists, chemists, *etc.* Subdisciplines within geology follow the numerical coding in the AGI *Directory*. Citations have been counted in *Science Citation Index 1988*, but I have **not** included any self-citations. Departments not listed in the AGI *Directory (i.e.*, departments of geophysics such as York University, and geography departments such as University of Victoria, Lethbridge, *etc.*) cannot be included in some tables because the total number of appropriate faculty is not given.

Problems

I have had to use judgement in counting citations for some people ("J. Smith") who appear to publish in *Geological Society of America Bulletin* as well as the *Journal of Brain Surgery*. One or two faculty members have moved during the year, and have grants listed under two different departments; they were treated as two different people in two departments, but as one person when overall averages were calculated. In rare cases, the AGI *Directory* listed one affiliation, but NSERC listed a different one. In the hope that NSERC dispatched the funds to the right place, I have relied on their affiliations. In other rare cases, the AGI *Directory* lists grantees as Assistant Professors, but NSERC lists them as University Research Fellows. Again, I have gone with NSERC's description. Northern Supplements have been included in the regular operating grants for the few faculty who have them. I do not think these problems distort the overall survey.

Basic Facts

Committee 10 gave out $12,577,089 to 525 recipients, making an average grant of $23,956.36. Of this, $8,601,118 (68%) was given to 329 GG Core Grantees, making an average grant of $26,143.22. There are 163 GG Core faculty who do not receive NSERC Operating Grants.

The Average Canadian Geoscience Grant Recipient

The average recipient in the GG Core receives $26,143.22. He/she has 17.8 years of experience since receiving the PhD degree, and his/her work was cited 17.8 times in 1988 (these two 17.8 numbers are a coincidence, not an error!).

Departmental Tabulations

As in previous years, the first tables present departmental listings. Table 1 shows the total money allotted by Committee 10 divided by the total number of recipients. Compared with last year, Laurentian, New Brunswick, Victoria and Waterloo have dropped from the top ten, being replaced by Dalhousie, Guelph, McGill and Queen's (listed in alphabetical order). Table 2 shows the total dollars allotted to the GG Core departments divided by the number of GG Core recipients in each department. Compared with last year, Alberta, Memorial and York drop from the top ten, being replaced by McGill, New Brunswick and Queen's. In Table 3, I have taken the dollars allotted to the GG Core, but have divided by the total number of GG Core faculty in each department (regardless of whether they are grantees or not) — this should give an idea of departmental funding strengths "across the board". Compared with last year, Guelph, Queen's and Saskatchewan join the top ten, at the expense of Alberta, Montreal and Waterloo.

It is noticeable that this year's top departments in Table 2 (Saskatchewan, Western Ontario and Toronto) are all departments hosting "star" faculty (Table 4).

The Star System

As far as I am aware, NSERC has made no public statement about a "star" system. It is clear from my surveys of the granting levels for the last three years that the "top recipients" are receiving larger and larger grants. In Table 4, I have listed the top 10% of the recipients; they account for nearly 27% of the money allotted to GG Core recipients. Grantees with equal grants are listed alphabetically.

Grants Within Subdisciplines

Whilst entering the data into my computer, I entered the AGI code expressing the subdiscipline of each faculty member. In subdisciplines with nine or more recipients, summary statistics have been calculated (Table 5). I am surprised that Invertebrate Paleontology is so well funded (it is not commonly regarded as an expensive line of research). Paleomagnetism, in academic circles, seems to be better funded than D.T.A. Symons recently implied in his letter to GG Core faculty — obviously I cannot comment on work in government laboratories. The work in both geomagnetism and paleomagnetism is funded slightly above average, and is cited slightly more frequently than average (17.8 citations). It is interesting that only three grant recipients classify themselves as stratigraphers; there are only two environmental geologists, one vertebrate paleontologist and one soil scientist.

Citations

Science Citation Index seems to be loved or hated. Clearly, the Index must be used intelligently, and it must be recognized that (1) only the first authors of papers are included; (2) despite wide journal coverage, some subdisciplines of geology are not surveyed as widely as others; (3) authors of review papers, or papers that establish widely used techniques, tend to be widely cited; (4) many citations are, in fact, self-citations (the

Table 1 Average grant: total dollars per University divided by total number of recipients.

University	Average Grant ($)	No. of recipients
McMaster	32,282.34	20
Toronto	26,566.83	44
Dalhousie	26,279.71	29
McGill	25,608.38	22
Guelph	25,455.70	10
Western Ontario	24,577.69	23
AVERAGE	***23,956.36***	
York	22,911.27	11
British Columbia	22,627.93	38
Alberta	21,618.49	33
Saskatchewan	19,868.67	17
Queen's	19,656.57	23
Manitoba	19,368.53	15
Memorial	18,949.61	33
Victoria	18,662.00	6
Montreal	17,847.13	14
Waterloo	17,844.69	20
Lakehead	17,590.75	7
Ottawa	16,861.37	17
New Brunswick	15,741.07	8
Carleton	15,436.25	13
Cape Breton	15,000.00	1
Calgary	14,368.26	19
St. Mary's	14,317.20	4
Laval	11,631.11	13
Québec à Rimouski	11,236.20	5
Québec à Montreal	10,520.40	11
Windsor	9,988.27	7
INRS Georessources	8,883.00	7
Brock	7,510.75	4
Laurentian	7,473.20	3
École Polytechnique	6,221.00	5
Acadia	6,005.75	3
Mt. Allison	5,902.50	3
Québec à Chicoutimi	5,443.00	3
St. Francis Xavier	3,893.33	1
Regina	3,714.29	3
Concordia	1,668.57	1

Table 2 Average GG Core Grant: total dollars divided by number of grantees.

University	Average grant ($)	No. of grantees
Saskatchewan	40,718.80	10
Western Ontario	36,320.94	16
Toronto	35,466.00	33
Laurentian	33,442.00	2
McMaster	33,017.31	13
British Columbia	29,834.52	21
York	28,180.34	6
Manitoba	27,915.00	11
McGill	27,800.71	14
Waterloo	27,484.34	12
New Brunswick	27,310.86	7
Queen's	26,524.59	17
Guelph	26,386.40	5
AVERAGE	***26,143.21***	
Memorial	26,039.08	25
Alberta	24,037.52	21
Ottawa	23,988.60	10
Montreal	23,858.33	9
Calgary	23,145.07	14
Lakehead	22,121.00	6
Québec à Montréal	21,739.38	8
Dalhousie	21,688.50	12
Carleton	20,909.90	10
École Polytechnique	19,650.00	4
St. Mary's	17,896.50	4
Acadia	16,015.33	3
Windsor	15,845.17	6
Brock	15,021.50	4
Cape Breton	15,000.00	1
Laval	14,391.86	7
St. Francis Xavier	11,680.00	1
INRS Georessources	10,824.50	6
Mt. Allison	10,350.00	2
Québec à Chicoutimi	8,333.33	3
Regina	9,000.00	2

Table 3 Average GG Core Grant: total dollars divided by total number of GG Core faculty.

University	Average Grant ($)	Number of Faculty *
McMaster	30,658.93	14
Toronto	29,259.45	40
Western Ontario	28,066.18	22
Guelph	26,386.40	5
McGill	24,325.63	16
Saskatchewan	22,621.56	18
British Columbia	21,604.31	29
Queen's	20,496.27	22
Manitoba	20,471.00	15
Ottawa	19,990.50	12
Memorial	19,726.58	33
Montreal	19,520.45	11
Lakehead	18,960.86	7
Dalhousie	18,590.14	14
AVERAGE	***17,236.71***	
Cape Breton	15,000.00	1
Waterloo	14,991.54	22
Carleton	14,935.64	14
New Brunswick	14,705.85	13
Alberta	14,422.51	35
St. Mary's	14,317.20	5
Calgary	12,462.73	26
Québec à Montréal	9,661.94	18
Windsor	9,507.10	10
INRS Georessources	8,118.38	8
Brock	7,510.75	8
Laurentian	7,431.56	9
Laval	7,195.93	14
Acadia	6,005.75	8
École Polytechnique	5,614.29	14
Mt. Allison	4,140.00	5
St. Francis Xavier	3,893.00	3
Regina	3,000.00	6
Québec à Chicoutimi	2,800.00	10
Concordia	0.00	6
Brandon	0.00	3

Table 4 Top ten percent GG Core recipients, arranged by grant amount: average grant is $26,143.21.

Recipient	Grant ($)	Cumulative Percent of Grant Money	Cumulative Percent of Recipients
Fyfe, W.S.	151,326	1.76	0.30
Kerrich, R.	125,000	3.21	0.61
York, D.	119,000	4.60	0.91
Dunlop, D.J.	96,474	5.72	1.22
Naldrett, A.J.	94,670	6.82	1.52
Strong, D.F.	84,670	7.80	1.82
Hawthorne, F.C.	79,326	8.73	2.13
Armstrong, R.L.	77,890	9.63	2.43
Veizer, J.	77,890	10.54	2.74
Chapman, C.H.	75,000	11.41	3.04
James, N.P.	72,945	12.26	3.34
Walker, R.G.	71,280	13.09	3.65
Longstaffe, F.J.	66,884	13.86	3.95
Stearn, C.W.	66,884	14.64	4.26
West, G.F.	66,700	15.42	4.56
Cherry, J.A.	63,214	16.15	4.86
Schwarcz, H.P.	62,824	16.88	5.17
Clarke, G.J.C.	62,214	17.60	5.47
Krogh, T.E.	59,670	18.30	5.78
Copper, P.	58,884	18.98	6.08
Ghent, E.D.	56,884	19.64	6.38
Williams, H.	55,000	20.28	6.69
Hillaire-Marcel, C.	54,500	20.92	6.99
Fleet, M.A.	54,300	21.55	7.29
Oldenburg, D.W.	54,280	22.18	7.60
Mitchell, R.H.	53,481	22.80	7.90
Smith, J.L.	51,000	23.39	8.21
Mereu, R.F.	49,500	23.97	8.51
Clowes, R.M.	48,614	24.54	8.81
Pickerill, R.K.	48,614	25.10	9.12
Westermann, G.E.G.	48,614	25.67	9.42
Williams, P.F.	48,614	26.23	9.73
Hall, J.	47,000	26.78	10.03

Table 5 Average grants by AGI subject classification. Only categories with nine or more grantees are listed.

AGI Classification	Average Grant	Grantees	Average Citation
Stable Isotopes	46,8433.11	9	28.11
Invertebrate paleontology	35,686.90	10	14.80
Seismology	34,680.33	12	17.42
General geochemistry	32,590.82	11	26.73
Geochronology, radioisotopes	29,828.00	16	31.69
Geomagnetism, paleomagnetism	29,052.67	9	19.22
General geophysics	27,745.27	11	13.27
Low temperature geochemistry	27,615.00	11	20.18
AVERAGE	***26,024.17***		
Economic geology, metals	25,103.00	16	12.44
Mineralogy, crystallography	24,270.09	11	23.27
Igneous petrology	23,553.38	21	17.29
Metamorphic petrology	22,640.00	11	16.36
Sedimentology, sedimentary petrology	22,362.45	31	19.19
Srtuctural geology	20,299.67	21	12.76

Note: about 60% of GG Core grantees are included in this table.

Table 6 Average citations: total citations divided by total number of GG Core faculty.

University	Average Citations
McMaster	30.14
Toronto	28.83
British Columbia	19.48
Lakehead	18.57
Ottawa	18.54
Western Ontario	15.78
Saskatchewan	15.71
Alberta	15.64
Queen's	14.77
Montreal	13.75
Dalhousie	13.69
AVERAGE	***13.40***
Manitoba	13.19
Memorial	12.91
Calgary	12.08
Guelph	11.40
St. Mary's	11.00
McGill	10.93
Carleton	10.43
Waterloo	9.86
Brock	9.00
Windsor	8.60
Acadia	7.86
New Brunswick	7.38
Laurentian	6.89
Regina	6.83
Québec à Montréal	6.47
Laval	4.38
Cape Breton	3.00
INRS Georessources	2.88
Mt. Allison	2.80
École Polytechnique	2.79
Québec à Chicoutimi	2.40
Concordia	2.00
St. Francis Xavier	2.00

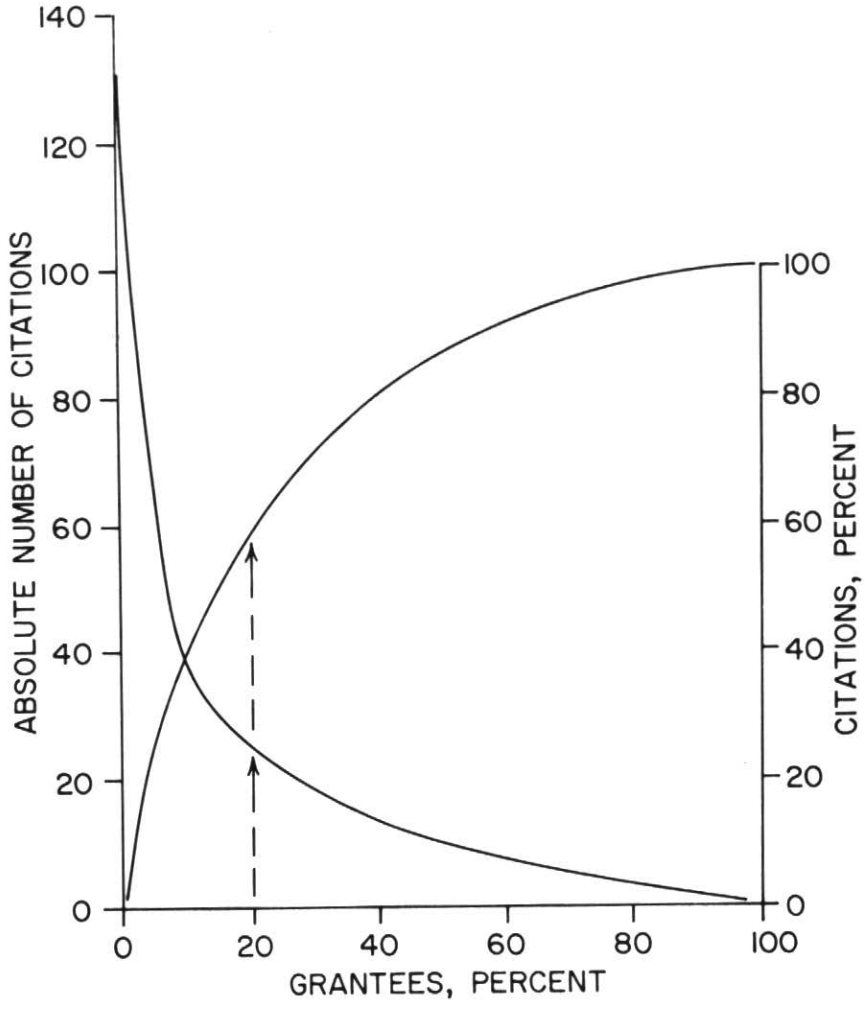

Figure 1 *Relationship of grant recipients and citations.*

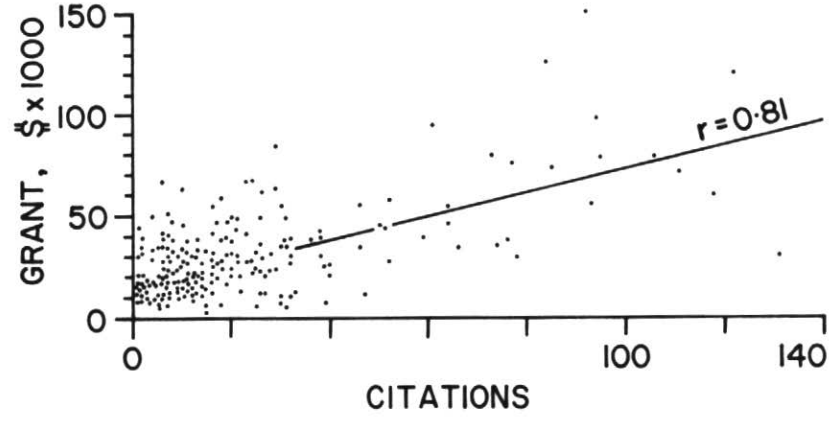

Figure 2 *Frequency of citation* versus *funding level.*

Canadian champion cited him/herself 43 times); and (5) the citation patterns in some fields are different from others (*e.g.*, the citation of old, but classic, technique papers). I have counted the citations (**not** including self-citations) for all GG Core faculty, and some very interesting patterns emerge. I am not aware of any similar studies; none of the references in *Science Citation Index* refer to individual citation patterns.

The GG Core grant recipients were cited an average of 17.8 times. The remaining 163 GG Core faculty without Operating Grants were cited an average of 4.95 times. The average citation for all GG Core faculty is 13.40. The citation records of the various departments across Canada are shown in Table 6; all faculty, not just grantees, are included. Clearly, the McMaster and Toronto departments produce work that is cited much more frequently than that of other departments. On an individual basis, the top 10% of grant recipients account for over 40% of all citations, and 10% of the citations are to the top 1.5% of recipients (Figure 1). In Figure 1, the arrows indicate how to read the graphs; only 20% of the grantees are cited more than about 25 times, and the top 20% of grantees account for nearly 60% of all citations. Both curves were plotted using all available data points (329 grantees).

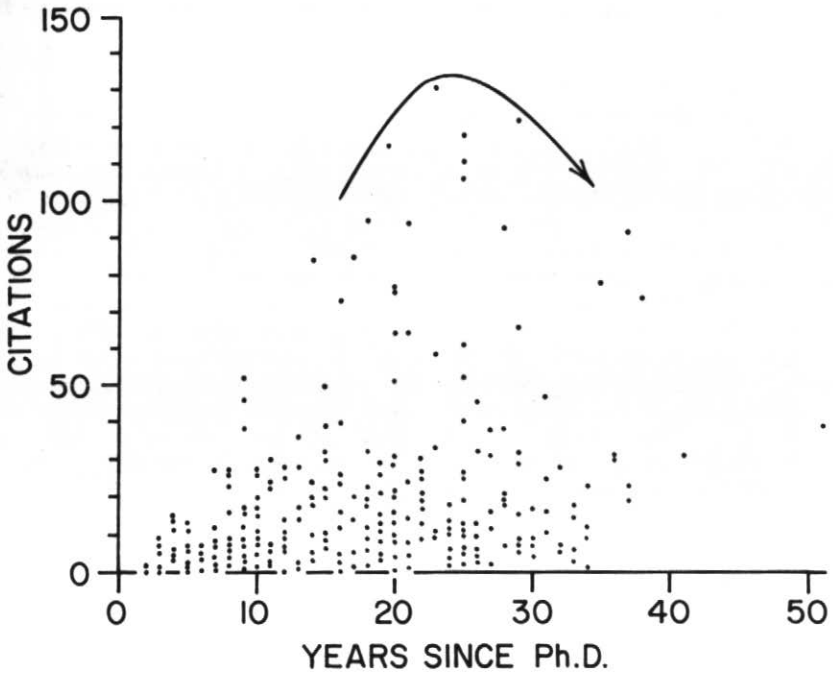

Figure 3 *Number of citations* versus *years since receipt of PhD.*

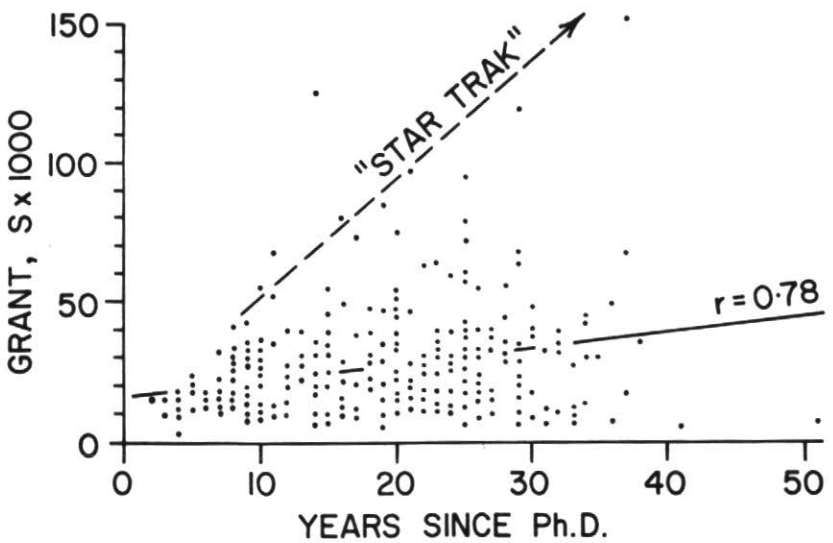

Figure 4 *Size of grant* versus *years since receipt of PhD.*

The relationship between funding level and frequency of citation is shown in Figure 2. There is a strong correlation (r=0.81), but the correlation co-efficient is strongly influenced by the top 10% of the grantees (citations over 39 in Figure 2). It is hoped that many factors influence the size of grants allotted, but the deliberations of Committee 10 appear to have effectively recognized the GG Core faculty whose work is widely cited in the journals.

One may ask how citation patterns vary with years in the profession. This is shown in Figure 3, where citations are plotted against years since the recipient received his/her PhD. Based on a limited number of data points, the peak appears to be about 25 years. This may reflect the explosive growth of geology departments in the mid-1960s, and if some of the frequently cited workers remain active, the peak may shift toward 30 or more years.

Finally, in Figure 4, I have plotted grant size against years since receipt of PhD. The correlation co-efficient is 0.78, and the graph suggests a modest grant increase for most workers with age. Surprisingly, there is no gradual "tailing off" of grants, and the distribution seems to end abruptly at about 38 years for all grant levels. Perhaps of greater interest is the structure of the "Star Trak", where relatively young workers are zooming up rapidly toward high grants.

Conclusions

Perhaps the main point to emerge from this analysis is the good correlation between granting level and frequency of citation. This applies on both an individual and departmental level. NSERC claims that grants reflect the quality of the proposal and the quality (rather than quantity) of the applicant's research. If high-quality work on important topics is the type of work that becomes widely cited, then the correlation between citations and funding is not surprising.

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