

Current Comments

Journal Citation Studies. 32. Canadian Journals, Part I: What They Cite and What Cites Them

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In the fall of 1977, we published a citation study of Canadian journals by Claude T. Bishop of the National Research Council of Canada.¹ In that study, Bishop ranked Canadian journals included in the 1975 *Science Citation Index*[®]'s (*SCI*[®]) *Journal Citation Reports*[®] (*JCR*[™]) (uses 1974 data) in terms of absolute citation and impact. Impact is a measure of the average frequency of citation each article in a journal received in a given year. Bishop compared his ranking of Canadian journals with the rest of the more than 2,500 source journals in the *SCI* data base.

At that time, I promised to follow up Bishop's study using a somewhat different approach, one similar to that which I adopted for my study of French, Italian, and other national groupings of journals. This approach treats a particular group of journals, in this case Canadian, as though they were one large *Canadian Journal of Science*. This first part of a two-part study shows primarily what Canadian journals cite, and what cites them.

The data come from the 1977 *SCI*. Table 1 lists for each of 46 Canadian journals total citations and impact factor. The world rank for both measures is also shown.

Altogether these journals published 5,474 articles in 1977, an average of 119 articles per year per journal. This accounts for 1.7% of the 319,403 source items processed for the *JCR* that year. Articles in the Canadian journals contained 103,631 citations, or 1.74% of the 5,947,313 citations processed. Each article averaged 18.9 citations, as com-

pared with 18.6 citations for the entire *JCR* file.

The 5,500 articles mentioned above were not published solely by Canadian scientists. Nor do they represent the total output of Canadian scientists. Indeed, Canadians published an estimated 12,393 articles in *SCI* journals in 1977. This number is based on *SCI* first-author data.

Table 2 lists the 50 journals most cited by Canadian journals. These journals accounted for only 26% of the Canadian citations. Twelve of the journals are Canadian. They accounted for 28% of the Canadian citations to the top 50. Does this indicate that Canadian journals have a national bias? If there were no national bias, we would expect to see Canadian journals cited only in proportion to their share of the world literature (less than 2%). (Don't confuse this typical national bias, i.e., receiving citations from other Canadian journals, with self-citation, i.e., the common tendency for a journal to cite itself.)

In Table 2 (column F) one finds that for half of the Canadian journals on the list, more than 80% of the citations they received from Canadian journals were self-citations. This suggests that the heavy citation of Canadian journals by Canadian journals is due more to self-citation than to national bias. In fact, none of the Canadian journals in the top 50 are on the list because of the citations they received from other Canadian journals. Column B shows that it takes at least 250 citations from Canadian journals for a Canadian journal to make the list. Column G shows that no Canadian

Table 1. Canadian journals indexed by the *Science Citation Index* in 1977.

| | Number of Times Cited | World Rank In Citations | Impact | World Rank In Impact |
|-----------------------------|--------------------------|----------------------------------|--------|-------------------------------|
| Arctic | 118 | 2,154 | .22 | 2,133 |
| Canad. Anaesth. Soc. J. | 725 | 1,008 | 1.19 | 720 |
| Canad. Entomol. | 1,534 | 586 | .59 | 1,378 |
| Canad. Geotech. J. | 102 | 2,214 | .25 | 2,068 |
| Canad. J. Anim. Sci. | 648 | 1,073 | .68 | 1,241 |
| Canad. J. Behav. Sci. | 192 | 1,872 | .53 | 1,455 |
| Canad. J. Biochem. | 3,157 | 311 | 1.83 | 412 |
| Canad. J. Bot. | 3,386 | 284 | .99 | 868 |
| Canad. J. Chem. | 10,742 | 70 | 1.61 | 494 |
| Canad. J. Chem. Eng. | 848 | 904 | .62 | 1,320 |
| Canad. J. Comp. Med. | 539 | 1,210 | .80 | 1,095 |
| Canad. J. Earth Sci. | 1,572 | 570 | 1.08 | 801 |
| Canad. J. Genet. Cytol. | 1,018 | 798 | .93 | 929 |
| Canad. J. Math. | 751 | 986 | .24 | 2,111 |
| Canad. J. Med. Technol. | 43 | 2,560 | .18 | 2,256 |
| Canad. J. Microbiol. | 2,936 | 332 | 1.11 | 774 |
| Canad. J. Neurol. Sci. | 106 | 2,198 | .64 | 1,303 |
| Canad. J. Ophthalmol. | 258 | 1,694 | .37 | 1,787 |
| Canad. J. Pharm. Sci. | 143 | 2,047 | .56 | 1,417 |
| Canad. J. Phys. | 4,559 | 208 | 1.20 | 715 |
| Canad. J. Physiol. Pharm. | 2,138 | 429 | 1.40 | 594 |
| Canad. J. Plant Sci. | 943 | 841 | .48 | 1,530 |
| Canad. J. Psychol. | 576 | 1,159 | .56 | 1,412 |
| Canad. J. Soil Sci. | 539 | 1,210 | .52 | 1,477 |
| Canad. J. Spectrosc. | 103 | 2,210 | .47 | 1,568 |
| Canad. J. Surg. | 445 | 1,335 | .57 | 1,408 |
| Canad. J. Zool. | 2,111 | 436 | .90 | 966 |
| Canad. Med. Assoc. J. | 3,437 | 281 | .95 | 908 |
| Can. Metall. Q. | 174 | 1,936 | .33 | 1,875 |
| Canad. Psychol. Rev. | 20 | 2,714 | .11 | 2,451 |
| Canad. Rev. Soc. Anthro. | 13 | 2,752 | .08 | 2,518 |
| Canad. Vet. J. | 259 | 1,691 | .41 | 1,691 |
| Clin. Biochem. | 389 | 1,423 | .84 | 1,040 |
| Forest Chron. | 99 | 2,231 | .26 | 2,048 |
| Geosci. Canada | 61 | 2,443 | .67 | 1,251 |
| J. Can. Assoc. Radiol. | 235 | 1,753 | .35 | 1,826 |
| J. Can. Dent. Assoc. | 129 | 2,108 | .14 | 2,355 |
| J. Canad. Petrol. Technol. | 27 | 2,670 | .15 | 2,349 |
| J. Fish. Res. Bd. Canada | 4,071 | 238 | 1.35 | 622 |
| J. Rheumatol. | 340 | 1,509 | 1.58 | 508 |
| J. Roy. Astron. Soc. Canada | 115 | 2,165 | .31 | 1,911 |
| Mem. Entomol. Soc. Canada | 72 | 2,380 | .43 | 1,641 |
| Pulp & Paper—Canada | 442 | 1,342 | .29 | 1,965 |
| Rev. Canad. Biol. | 324 | 1,533 | .46 | 1,573 |
| Science Forum | 9 | 2,780 | .06 | 2,568 |
| Union Med. Canada | 362 | 1,473 | .15 | 2,322 |

journal received more than 219 citations from other Canadian journals.

The appearance of heavy self-citation on the part of Canadian journals changes when we examine the ratio of self-citations to the *total* citations received from all journals. For seven of

the 12 Canadian journals listed, self-citations accounted for 20% or less of the total citations received. Based on what we found when we studied the journals of Germany,² France,³ and Italy,⁴ this is about normal. The highest ratio of self-citations to total citations

Table 2: The 50 journals cited most by Canadian journals. A = total citations received. B = Canadian citations received. C = self-citations. D = % of total citations which are Canadian citations (B/A). E = % of total citations which are self-citations (C/A). F = % of Canadian citations which are self-citations (C/B). G = citations from Canadian journals exclusive of self-citations (B-C).

| | A | B | C | D | E | F | G |
|------------------------------|---------|-------|-------|------|------|------|-----|
| J. Amer. Chem. Soc. | 103,958 | 2,168 | — | 2.1 | — | — | — |
| J. Fish. Res. Board Canada | 4,071 | 1,400 | 1,181 | 34.9 | 29.4 | 84.4 | 219 |
| J. Biol. Chem. | 96,852 | 1,308 | — | 1.4 | — | — | — |
| Canad. J. Chem. | 10,742 | 1,306 | 1,254 | 12.2 | 11.7 | 96.0 | 52 |
| J. Chem. Phys. | 68,490 | 1,244 | — | 1.8 | — | — | — |
| Nature | 73,507 | 920 | — | 1.3 | — | — | — |
| Biochem. Biophys. Acta | 61,470 | 832 | — | 1.4 | — | — | — |
| Science | 55,990 | 801 | — | 1.4 | — | — | — |
| Canad. J. Bot. | 3,386 | 796 | 680 | 23.5 | 20.1 | 85.4 | 116 |
| New Engl. J. Med. | 39,129 | 659 | — | 1.7 | — | — | — |
| Canad. J. Earth Sci. | 1,572 | 650 | 588 | 41.4 | 37.4 | 90.5 | 62 |
| Lancet | 47,214 | 631 | — | 1.3 | — | — | — |
| J. Bacteriol. | 20,305 | 587 | — | 2.9 | — | — | — |
| Canad. Entomol. | 1,534 | 586 | 467 | 38.2 | 30.4 | 79.7 | 119 |
| J. Phys. Chem.—US | 19,337 | 574 | — | 3.0 | — | — | — |
| P. Nat. Acad. Sci. USA | 65,530 | 557 | — | 0.9 | — | — | — |
| Canad. J. Zool. | 2,111 | 522 | 371 | 24.7 | 17.6 | 71.1 | 151 |
| J. Org. Chem. | 28,844 | 515 | — | 2.1 | — | — | — |
| Biochem. J. | 24,104 | 487 | — | 1.4 | — | — | — |
| Phys. Rev. | 42,027 | 449 | — | 1.1 | — | — | — |
| Biochemistry—US | 35,431 | 442 | — | 1.3 | — | — | — |
| Canad. J. Microbiol. | 2,936 | 424 | 327 | 14.4 | 11.1 | 77.1 | 97 |
| Canad. J. Phys. | 4,559 | 419 | 392 | 9.2 | 8.6 | 93.6 | 27 |
| Canad. Med. Assoc. J. | 3,437 | 415 | 334 | 12.1 | 9.7 | 80.5 | 81 |
| J. Chem. Soc. | 17,271 | 410 | — | 2.4 | — | — | — |
| J. Physiol.—London | 27,804 | 369 | — | 1.3 | — | — | — |
| Canad. J. Biochem. | 3,157 | 361 | 242 | 11.4 | 7.7 | 67.0 | 119 |
| Tetrahedron Lett. | 21,450 | 354 | — | 1.7 | — | — | — |
| Amer. J. Physiol. | 23,821 | 353 | — | 1.5 | — | — | — |
| Biochem. Biophys. Res. Comm. | 28,013 | 348 | — | 1.2 | — | — | — |
| T. Amer. Fish. Soc. | 1,358 | 346 | — | 25.5 | — | — | — |
| Canad. J. Plant Sci. | 943 | 333 | 256 | 35.3 | 27.2 | 76.9 | 77 |
| J. Pharmacol. Exp. Ther. | 15,658 | 332 | — | 2.1 | — | — | — |
| J. Clin. Invest. | 30,930 | 328 | — | 1.1 | — | — | — |
| J. Amer. Med. Assoc. | 20,905 | 316 | — | 1.5 | — | — | — |
| Brit. Med. J. | 26,408 | 309 | — | 1.2 | — | — | — |
| Ecology | 4,453 | 307 | — | 6.9 | — | — | — |
| J. Gen. Microbiol. | 6,374 | 302 | — | 4.7 | — | — | — |
| Circulation | 22,764 | 301 | — | 1.3 | — | — | — |
| Plant Physiol. | 10,440 | 291 | — | 2.8 | — | — | — |
| Phytopathology | 4,728 | 281 | — | 5.9 | — | — | — |
| Geol. Soc. Amer. Bull. | 4,781 | 277 | — | 5.8 | — | — | — |
| J. Cell Biol. | 22,850 | 270 | — | 1.2 | — | — | — |
| J. Chem. Soc. Chem. Comm. | 15,724 | 270 | — | 1.7 | — | — | — |
| Amer. J. Botany | 3,676 | 268 | — | 7.3 | — | — | — |
| Canad. J. Physiol. Pharm. | 2,138 | 268 | 211 | 12.5 | 9.9 | 78.7 | 57 |
| J. Anim. Sci. | 4,700 | 265 | — | 5.6 | — | — | — |
| Arch. Biochem. Biophys. | 17,848 | 262 | — | 1.5 | — | — | — |
| Phys. Rev. Lett. | 37,099 | 256 | — | 0.7 | — | — | — |
| J. Geophys. Res. | 15,516 | 250 | — | 1.6 | — | — | — |

received was 37.4% for the *Canadian Journal of Earth Science*.

It is not surprising that the *Journal of the American Chemical Society* is the most-cited journal, since it is the most-cited journal in most of our studies. Would you have guessed that the *Jour-*

nal of the Fisheries Research Board of Canada would rank second? It is closely followed by the *Journal of Biological Chemistry* and the *Canadian Journal of Chemistry*. Although the *Journal of Chemical Physics* is fifth, the list has a decidedly life science bias.

Table 3. The 50 journals which most frequently cite Canadian journals. A = citations to all journals. B = citations to Canadian journals. C = self-citations. D = % of citations to all journals which are to Canadian journals (B/A). E = % of total citations which are self-citations (C/A). F = % of Canadian citations which are self-citations (C/B). G = citations to Canadian journals exclusive of self-citations (B-C).

| | A | B | C | D | E | F | G |
|----------------------------|--------|-------|-------|------|------|------|-----|
| J. Fish. Res. Board Canada | 7,035 | 1,315 | 1,181 | 18.7 | 16.8 | 90.0 | 132 |
| Canad. J. Chem. | 14,167 | 1,307 | 1,254 | 9.2 | 8.9 | 96.0 | 52 |
| Canad. J. Bot. | 7,245 | 816 | 680 | 11.3 | 9.4 | 83.3 | 136 |
| J. Amer. Chem. Soc. | 55,765 | 731 | — | 1.3 | — | — | — |
| Canad. J. Earth Sci. | 6,411 | 673 | 588 | 10.5 | 9.2 | 87.4 | 85 |
| Canad. J. Zool. | 5,537 | 636 | 371 | 11.5 | 6.7 | 58.3 | 265 |
| Canad. Entomol. | 2,863 | 569 | 467 | 19.9 | 16.3 | 82.1 | 102 |
| J. Chem. Phys. | 42,660 | 552 | — | 1.3 | — | — | — |
| Canad. J. Microbiol. | 5,234 | 415 | 327 | 7.9 | 6.3 | 78.8 | 88 |
| J. Org. Chem. | 25,644 | 409 | — | 1.6 | — | — | — |
| Canad. J. Phys. | 4,523 | 404 | 392 | 8.9 | 8.7 | 97.0 | 12 |
| Canad. Med. Assoc. J. | 5,399 | 382 | 334 | 7.1 | 6.2 | 87.4 | 48 |
| Canad. J. Plant Sci. | 2,268 | 340 | 256 | 15.0 | 11.3 | 75.3 | 84 |
| Biochim. Biophys. Acta | 54,686 | 288 | — | 0.5 | — | — | — |
| Canad. J. Biochem. | 5,016 | 282 | 242 | 5.6 | 4.8 | 85.8 | 40 |
| Carbohyd. Res. | 6,467 | 280 | — | 4.3 | — | — | — |
| Canad. J. Physiol. Pharm. | 4,990 | 279 | 211 | 5.6 | 4.2 | 75.6 | 68 |
| J. Water Pollut. Con. F. | 8,936 | 269 | — | 3.0 | — | — | — |
| J. Chem. Soc. Perk. T. 2 | 10,875 | 248 | — | 2.3 | — | — | — |
| Canad. J. Anim. Sci. | 1,658 | 245 | 209 | 14.8 | 12.6 | 85.3 | 36 |
| Inorg. Chem. | 19,824 | 226 | — | 1.1 | — | — | — |
| J. Fish. Biol. | 3,754 | 226 | — | 6.0 | — | — | — |
| Chem. Phys. Lett. | 17,422 | 221 | — | 1.3 | — | — | — |
| J. Phys. Chem.—US | 13,338 | 212 | — | 1.6 | — | — | — |
| Tetrahedron | 14,877 | 200 | — | 1.3 | — | — | — |
| J. Organomet. Chem. | 21,287 | 194 | — | 0.9 | — | — | — |
| Nature | 31,602 | 193 | — | 0.6 | — | — | — |
| J. Bacteriol. | 16,692 | 190 | — | 1.1 | — | — | — |
| Phys. Rev. B. | 33,691 | 185 | — | 0.6 | — | — | — |
| Canad. J. Chem. Eng. | 2,607 | 183 | 164 | 7.0 | 6.3 | 89.6 | 19 |
| Union Med. Canada | 4,140 | 175 | 107 | 4.2 | 4.2 | 61.1 | 68 |
| Plant Physiol. | 9,445 | 173 | — | 1.8 | — | — | — |
| Environ. Entomol. | 2,445 | 171 | — | 7.0 | — | — | — |
| Tetrahedron Lett. | 14,021 | 170 | — | 1.2 | — | — | — |
| Canad. J. Soil Sci. | 977 | 169 | 132 | 17.3 | 13.5 | 78.1 | 37 |
| T. Amer. Fish. Soc. | 1,620 | 168 | — | 10.4 | — | — | — |
| Chem. Rev. | 8,187 | 164 | — | 2.0 | — | — | — |
| J. Molec. Spectrosc. | 4,071 | 163 | — | 4.0 | — | — | — |
| Mar. Biol. | 5,711 | 160 | — | 2.8 | — | — | — |
| Org. Magn. Resonance | 3,411 | 160 | — | 4.7 | — | — | — |
| B. Chem. Soc. Japan | 13,348 | 153 | — | 1.2 | — | — | — |
| Ann. Entomol. Soc. Amer. | 2,499 | 152 | — | 6.1 | — | — | — |
| Canad. J. Genet. Cytol. | 1,725 | 147 | 111 | 8.5 | 6.4 | 75.5 | 36 |
| Amer. J. Vet. Res. | 7,181 | 145 | — | 2.0 | — | — | — |
| Nucl. Phys. A | 18,174 | 145 | — | 0.8 | — | — | — |
| Phytopathology | 4,769 | 144 | — | 3.0 | — | — | — |
| J. Chem. Soc. Perk. T. 1 | 10,842 | 138 | — | 1.3 | — | — | — |
| J. Biol. Chem. | 41,654 | 134 | — | 0.3 | — | — | — |
| J. Inorg. Nucl. Chem. | 8,474 | 133 | — | 1.6 | — | — | — |
| Hydrobiologia | 3,507 | 132 | — | 3.8 | — | — | — |

If you combined the figures for the twelve Canadian journals in Chemistry, Botany, Earth Science, Entomology, Zoology, Microbiology, Physics, Medicine, Biochemistry, and Plant Science that follow the *Journal of Biological Chemistry* in Table 2, you

would have over 5,000 citations. Of these, most would go to the journals published by the National Research Council of Canada, whose output might be compared to that of *Comptes Rendus* or *Proceedings of the National Academy of Sciences—USA*.

As mentioned above, the 46 Canadian journals provided over 103,000 citations. However, they only received a little over 50,000 citations. Hence, the "balance of payments" is approximately 2 to 1 in favor of import against export. To put it another way, Canadian journals draw on foreign journals more than the rest of the world draws on them. As will be seen in part two of this study, this is not unexpected—the most important research done by Canadians is published outside of Canada!

Table 3 shows the list of journals that most frequently cite Canadian journals. Once again, the importance of the *Journal of the Fisheries Research Board of Canada* is obvious. Its appearance is not surprising, nor is the appearance of the other Canadian journals. But the appearance of the *Journal of the American Chemical Society*, the *Journal of Chemical Physics*, and the *Journal of Organic Chemistry* is interesting. We did not try to find out if this was because leading Canadian researchers publish in these journals also. Considering its size, the low profile of the *Physical Review* in Canada is interesting.

In Table 4 we have updated Bishop's 1974 data on the world ranking of the

top Canadian journals. This table shows the nine Canadian journals that achieved an impact factor of at least 1.0 during 1977, a distinction achieved by 30% of the journals we cover. These nine journals published about 40% of the Canadian journal articles, and received about 60% of the citations going to Canadian journals.

It is interesting to note the changes from Bishop's data over the three year period. While the *Canadian Journal of Earth Science* declined slightly, many Canadian life science journals have greater impact. One can only speculate on the reason for this. If the life science literature is increasing, we would expect the absolute number of citations to life science journals to rise. But this should not necessarily affect impact. However, in a separate study, we have observed that the average number of citations per article, especially in biochemistry, is increasing. This would account in part for increases in impact factors.⁵ I would prefer to attribute the increase to improved quality. One caveat about these impact numbers: the ranks indicate that we are guilty of doing what we tell others not to do. For example, if the *Journal of the Fisheries Research Board of Canada* ranks 622 with an impact of 1.35 then it should be compared, not to other Canadian journals, but rather to other fishery research journals. You can do this by consulting the last volume of the *SCI* which contains the *Journal Citation Reports*.

In the second part of this study, we will take a look at Canadian research and compare the impact of papers published at home with those published abroad. We'll also list the most-cited papers in these two categories.

Table 4. Canadian source journals with impact factors greater than 1.00 (1977 *Science Citation Index*)
A = impact. B = no. of citations received. C = world rank in impact.

| | A | B | C |
|---------------------------|------|--------|-----|
| Canad. J. Biochem. | 1.83 | 3,157 | 412 |
| Canad. J. Chem. | 1.61 | 10,742 | 494 |
| J. Rheumatol. | 1.58 | 340 | 508 |
| Canad. J. Physiol. Pharm. | 1.40 | 2,138 | 594 |
| J. Fish. Res. Bd. Canada | 1.35 | 4,071 | 622 |
| Canad. J. Phys. | 1.20 | 4,559 | 715 |
| Canad. Anaesth. Soc. J. | 1.19 | 725 | 720 |
| Canad. J. Microbiol. | 1.11 | 2,936 | 774 |
| Canad. J. Earth Sci. | 1.08 | 1,572 | 801 |

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*Reprinted in: Garfield E. *Essays of an information scientist*. Philadelphia: ISI Press. 1977. 2 vols.