""""" "current comments"

Citations-to divided by Items-Published Gives Journal Impact Factor; ISI® Lists the Top Fifty High-Impact Journals of Science

Previously, we have published lists of most-cited authors,1 journal articles.² journals.³ and books.⁴ Each of those lists was used to illustrate how the Science Citation Index @ data base, now over twenty million citations, can be used to assess various aspects of science policy, communication, etc. Following these introductory remarks there is another ranked list of journals arranged by "impact factor". For each journal in the list there is also given its rank in a much larger list of most-cited journals. These fifty represent the top 10% out of over 565 journals studied to date which account for over 75% of the citations in the literature. The data are based on a sample of about one million citations processed for the last guarter of the 1969 Science Citation Index.

It has always been and still remains difficult to assess the relative importance of scientific journals. There are few, if any, totally objective criteria by which to measure them. Many librarians learn in time those journals that are most "important" for particular disciplines and there have been almost countless studies to establish lists. Special librarians also know the research needs for particular organizations.

But when choices must be made, when one must live within a tight acquisitions budget, choosing journals in a "rational" manner can become a highly political problem. Citation data may help the harassed librarian or

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library committee chairman establish a rationale for selections.

As indicated elsewhere,5 citation frequency is biased in favor of large journals. If a journal has published 1000 articles it is more likely to be cited than a journal that has published only 20--all other things being equal. Almost a decade ago, ISI developed the concept of a journal's impact.6 (A recent rediscovery of the impact factor has been reported in Nature.7) Impact can be measured in various ways. The first method is to compute the ratio between citations to particular years of a journal and the number of articles published in those years. This is the method chosen here. One can also use the ratio of citations to the number of articles actually cited one or more times disregarding those which are not cited. I have called this latter the putative impact factor.

A very different ratio expresses the fraction of articles cited. One can also try to discount the "inbreeding" effect of self-citations. In contrast, so-called *journal utilization* factors⁶ indicate the number of different citing journals involved.

The ratio of citations to sources provides an overall measure of impact. Unless limited by chronological criteria the ratio can be skewed by a few supercited classics. A single article cited 500 times has the same effect as 100 articles cited five times--a very high impact factor. The putative impact factor, citations/cited sources, discounts the negative influence of articles which are never cited. For certain journals this may be significant depending upon one's definition of an article or citable item.

As the title of this editorial states we have computed impact factors by dividing the citations to the years 1967 and 1968 by the total number of articles published in 1967 and 1968. The citations counted appeared in the 1969 literature. In this way we have chosen a current impact factor which discounts the effect of most superclassics. About 25% of all citations are made to the two-year period prior to the source year chosen.⁸ If we had chosen 1964 and 1965 we would have had a different list. We intend to produce such analyses as time and energy permit.

Two things are immediately apparent. First, the list of 50 journals with the highest impact, current or otherwise, is quite different from the list of 50 most-cited journals. Only eleven journals appear on both lists. Second, almost half of the high-impact journals can be called review journals. None of them appears on the top 50 most-cited list, thus confirming a finding already reported. Articles which cite heavily, as reviews are very likely to do, are themselves cited heavily.⁹ For whatever reasons, the Golden Rule apparently extends even to bibliography.

While many review journals appear in this list, many do not. If all such journals were treated separately one could limit comparisons to journals presumably limited to original research. But this is not easy to do. Conspicuous by their absence are both Science and Nature. It would be important, therefore, to measure separately the impact of their lead or review atticles. The absence of the Physical Review, the Journal of Chemical Physics and the Journal of Applied Physics and the presence of Physical Review Letters may be a reflection of the immediacy factor.

Large-scale studies of this kind may, therefore, do certain journals an injustice. Any editor who wishes to examine his own journal in greater detail can do so by straightforward examination of the *Science Citation Index* or by contacting ISI for a more extensive computerized analysis. In future columns I will indicate the effect of socalled immediacy factors, among others, which show how quickly the journal in question is cited.

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- 6. & Sher, I.H. New Factors in the evaluation of scientific literature through citation indexing. American Documentation 14(3):195-201, 1963.
- 7. Sandison, A. Library optimum. [A letter to the editor of] Nature 234:368-369, 1971.
- 8. Institute for Scientific Information, Inc., Science Citation Index 1970 Guide and Journal Lists (Philadelphia: Institute for Scientific Information, 1971), p. 13.
- 9. Krauze, T.K. & Hillinger, C. Citations, references and the growth of scientific literature; a model of dynamic interaction. *Journal of the American Society for Information Science* 22(5):333-336, 1971.

List of Fifty Most-Cited Journals

Rank	Times Cited	Title		
1.	26263	Journal of the American Chemical Society		
2.	20674	Physical Review		
3.	17112	Journal of Biological Chemistry		
4.	15325	Nature		
5.	14028	Journal of the Chemical Society		
6.	13690	Journal of Chemical Physics		
7.	9752	Science		
8.	9550	Biochimica et Biophysica Acta		
9.	8260	Proceedings of the National Academy of Sciences of USA		
10.	7638	Biochemical Journal		
11.	7617	Lancet		
12.	6581	Physical Review Letters		
13.	5789	Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences		
14.	5420	American Journal of Physiology		
15.	5401	Journal of Organic Chemistry		
16.	5190	Journal of Applied Physics		
17.	5079	Proceedings of the Society for Experimental Biology and Medicine		
18.	4982	Journal of Molecular Biology		
19.	4966	Journal of Physiology (London)		
20.	4864	Proceedings of the Royal Society (London)		
21.	4813	Journal of Cell Biology		
22.	4785	Journal of Clinical Investigation		
23.	4703	Journal of Physical Chemistry		
24.	4541	Chemische Berichte		
25.	4512	New England Journal of Medicine		
26.	4492	Journal of the American Medical Association		
27.	4304	British Medical Journal		
28.	4271	Astrophysical Journal		
29.	4259	Analytical Chemistry		
30.	4167	Zhurnal Eksperimentalnoi i Teoreticheskoi Fiziki		
31.	4147	Journal of Bacteriology		
32.	4076	Biochemistry		
33.	4034	Nuclear Physics		
34.	3943	Physics Letters		
35.	3937	Tetrahedron Letters		
36.	3871	Journal of Experimental Medicine		
37.	3787	Annals of the New York Academy of Sciences		
38.	3689	Archives of Biochemistry and Biophysics		
39.	3537	Journal of Geophysical Research		
40.	3458	Journal of Polymer Science		
41.	3417	Biochemical and Biophysical Research Communications		
42.	3372	Federation Proceedings		
43.	3308	Journal of Physics		
44.	2922	Transactions of the Faraday Society		
45.	2917	Acta Crystallographica		
46.	2869	Doklady Akademii Nauk SSSR		
47.	2781	Journal of Pharmacology and Experimental Therapeutics		
48.	2728	Angewandte Chemie		
49.	2627	Journal of Immunology		
50.	2620	Fizika Tverdogo Tela		

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Rank	1969 Citations to 1967-8	1967-8 Source Items	impact Factor	Title & Rank on Most-Cited List
1.	820	28	29.29	Accounts of Chemical Research (542)
2.	184	8	23.00	Advances in Protein Chemistry (395)
3.	448	20	22.40	Pharmacological Reviews (211)
4.	804	39	20.62	Bacteriological Reviews (232)
5.	932	53	17.58	Annual Review of Biochemistry (320)
6.	572	33	17.33	Physiological Reviews (148)
7.	228	14	16.29	Solid State Physics (388)
8.	192	20	9.60	Advances in Enzymology (489)
9.	144	16	9.00	International Review of Cytology (565)
10.	7340	833	8.81	Journal of Molecular Biology (18)
11.	232	27	8.59	Recent Progress in Hormone Research (366)
12.	11548	1348	8.57	Proceedings National Academy of Sciences USA (9)
13.	2700	325	8.31	Journal of Experimental Medicine (36)
14.	452	55	8.22	Quarterly Reviews (309)
15.	408	50	8.16	Chemical Reviews (154)
16.	296	42	7.05	Annual Review of Plant Physiology (456)
17.	820	125	6.56	Journal of Crystal Growth (559)
18.	288	44	6.55	Annual Review of Microbiology (534)
19.	10768	1777	6.06	Journal of Biological Chemistry (3)
20.	80	14	5.71	Methods of Biochemical Analysis (495)
21.	6344	1114	5.69	Biochemistry (32)
22.	22156	3946	5.61	Journal of the American Chemical Society (1)
23.	612	109	5.61	Uspekhi Fizicheskikh Nauk (265)
24.	1060	194	5.64	Cold Spring Harbor Symposia on Quant Biol (140)
25.	176	34	5.18	Biological Reviews Cambridge Philosophical Soc (407)
26.	1860	360	5.17	Journal of Virology (278)
27.	240	48	5.00	Medicine (369)
28.	600	122	4.92	Journal of Cell Science (284)
29.	11380	2317	4.91	Physical Review Letters (12)
30 .	5440	1167	4.66	Astrophysical Journal (28)
31.	1784	395	4.51	American Journal of Medicine (62)
32.	3400	754	4.51	Zhurnal Eksperimentalnoi i Teoreticheskoi Fiziki (30)
33.	2620	584	4.49	Virology (57)
34.	692	156	4.44	Journal of Neurophysiology (150)
35.	368	83	4.43	Psychological Review (258)
36.	816	189	4.32	Reviews of Modern Physics (103)
37.	5108	1190	4.29	Biochemical and Biophysical Research Comm (41)
38.	1008	238	4.29	Monthly Notices of the Royal Astronomical Society (180)
39.	1820	432	4.21	Circulation Research (74)
10.	2992	726	4.12	Journal of Immunology (49)
41.	284	70	4.06	Quarterly Journal of Medicine (341)
12.	1672	417	4.01	Journal of the National Cancer Institute (76)
1 3.	1992	501	3.98	European Journal of Biochemistry (82)
14.	564	144	3.92	Molecular Pharmacology (474)
45. 14	552	142	2.07	Developmental Biology (345)
+0.	1888	466	3.81	Chaminal Engineer (Landorinology and Metadolism (69)
∔/. 40	392	104	3.11	Chemical Engineer (London) (520)
+ð.	876	255	3.13	Journal of Lipid Research (108)
+9. : 0	284	17	J.09 244	Advances in Physics (450) Peuchological Bulletin (245)
JU .	504	154	3.00	rsychological dulletin (245)