

The 1970 Papers Most Frequently Cited
from 1970-1973

Eugene Garfield, Ph.D., President
Institute for Scientific Information

December 19, 1973

Number 51

Recently we've reported on the most-cited papers written in 1971 and 1972.^{1,2} A similar list of 1970 papers appears on pages 7-8.

The papers are interesting not only for the historical information concerning research during 1970, but perhaps more so for what they tell us about laboratory research *right now*. These 1970 papers were heavily cited shortly after publication. Apparently, early heavy citation of such 'breakthrough' contributions is not inhibited as with most papers by the effects of publication time-lags.

The significance of such breakthrough papers becomes even clearer within one or two years after publication, as shown in the list of papers which follows. In almost all cases, citations of a "1970 paper heavily cited in 1970" increase to a peak within two or three years. For example, the paper by Roeder and Rutter on nucleolar and nucleoplasmic RNA polymerases (no. 15) was cited 25 times in 1970, 44 in 1971, 61 in 1972, and (an extrapolated) 88 in 1973.

With few exceptions, references to all the papers increased in number during 1971 and 1972. Based on data for the first nine months of 1973, we have extrapolated the full 1973 citation rate.³ In eleven cases an increase will have been sustained. Almost all of the eleven concern cellular protein and nucleic acid biochemistry. (Biochemistry is the subject of 22 out of 30 papers on the list. Five come from physics, and 3 from medicine.)

The paper by F.J. Gilman *et al.*, (no. 30) on helicity conservation in diffraction scattering seemed to hit the jackpot among physicists in 1971, but reference to it declined in 1972, and the decline has continued in 1973. It would be interesting to determine the reason for the decline. Has the paper already been superseded by subsequent advances? Undoubtedly this is true for the paper by Sanders & Williams (no. 14) on a shift reagent for NMR spectroscopy.

This list shows again that 'breakthroughs' in chemistry and physics will show up though research publication is disproportionately 'biased' toward the life sciences. Thus, the paper by Mueller on single-particle spectra, and the paper by Sanders & Williams on the shift reagent stand high in the list.

There is some concern that analysis of this kind, and lists of this kind, do not do justice to important papers in particular fields, e.g., geophysics. In the near future, I will single out the papers most cited in the *Journal of Geophysical Research*, among others. Clearly, it is not either 'fair,' or truly 'informative' in regard to particular specialties, to make comparison across fields on the basis of citation frequency alone. As far as citation analysis goes, we must determine 'best of breed' as well as 'best in show.' When we do, so-called narrow disciplines and apparently slow-moving disciplines like mathematics will prove to have their annual stellar citation attractions. If you are a

member of a committee that must select award-winning papers, you might do well to consider the use of such field-specific data. Middleton has recently prepared an interesting paper on this subject in the field of sedimentary petrology.⁴

The same kind of data is being used by editors of certain journals to compile lists of papers from their journals worthy of republication. While a super-classic may not have much effect on current research, it should of necessity be of historical interest to the younger generation, who may otherwise have little opportunity to appreciate the author's contribution.

A growing nostalgia of sorts is evident in many current fads—for example, television commercials proclaim the availability of collected musical 'hits',

the golden oldies, from the 30's, the 40's, the 50's, what have you. Citation analysis of earlier decades has a different purpose, but it would, nevertheless, be interesting to go back and see what theories and methods enjoyed a vogue in this or that decade only thereafter to drop from 'cite'. Perhaps there may be some such thing as scientific nostalgia.⁵ But whatever you call it, it concerns science historians. For this reason, among others, ISI[®] is now studying the need for a *Science Citation Index*[®] covering the period 1900-1960. The outcome will depend upon the support we can find among scientists, historians, librarians, and administrators. If this prospect excites you as it does me, please let me hear from you.

1. Garfield, E. Were the 1972 papers most cited in 1972 the most significant? *Current Contents* No 42, 17 October 1973, pp. 5-7.

2. The 25 most cited 1971 papers reveal a great deal about research in 1971. *Current Contents* No. 44, 31 October 1973, pp. 5-8.

3. These eleven articles are asterisked in the list on pages 7-8. As discussed in a previous editorial (reference 1, above), the earlier a paper is published during a particular year, obviously the better its chance of being cited that same year. Of the eleven articles among the 30 listed whose frequency of citation will sustain an increase during 1973 (on the basis of extrapolation of the January-September 1973 data given in the list), eight were published in June of 1970 or thereafter, and were cited only once or not at all during 1970. It may be, therefore, because of date of publication in 1970, that these eight have not yet peaked as most other papers on the list. Of the eleven, the three remaining, all published early in 1970

and heavily cited in 1970, may be the ones to watch (Roeder & Rutter, no. 15; Raff *et al.*, no. 16; and Kedinger *et al.*, no. 26). Their citation frequency should have peaked by now, all things being equal, but it continues to rise.

4. Middleton, G.V. Citation patterns of papers published in the *Journal of Sedimentary Petrology*. *J. Sediment. Petrol.*, in press for March 1974. Department of Geology, McMaster University, Hamilton 16, Ontario L8S 4M1, Canada.

5. This sort of research would certainly not be without value or interest. What reasons would one find for disappearance of papers most cited in the 30's or 40's? Were they absorbed into the general body of knowledge so as no longer to require explicit citation? Did their subjects prove to be trivial paths not worth tracing further, or (a very different matter) *cul-de-sacs* whose dead-end walls were built by lack of funds, lack of necessary knowledge or technology, a switch in interest or priority, etc.? How often would one find that basic error was involved?

The Thirty 1970 Papers Most Cited From 1970-1973.

| Rank | Total 1/70- 9/73 | Citations | | | | Bibliographical Data |
|------|------------------------|-----------|------|------|--------------------|--|
| | | 1970 | 1971 | 1972 | Jan.-Sept. 1973 | |
| 1. | 456 | 41 | 168 | 143 | 104 | Temin, H.M. & Mizutani, S. RNA-dependent DNA polymerase in virions of Rous sarcoma virus. <i>Nature</i> 226(5252):1211-1213, 27 June 1970. |
| 2. | 431 | 43 | 152 | 145 | 91 | Baltimore, D. Viral RNA-dependent polymerase: RNA-dependent DNA polymerase in virions of RNA tumour viruses. <i>Nature</i> 226(5252):1209-1211, 27 June 1970. |
| *3. | 371 | 1 | 115 | 134 | 121 | Taylor, A.L. Current linkage map of <i>Escherichia coli</i> . <i>Bacteriological Reviews</i> 34(2):155-75, June 1970. |
| *4. | 461 | 0 | 34 | 132 | 195 | Gilman, A.G. A protein binding assay for adenosine 3':5'-cyclic monophosphate. <i>Proc. Nat. Acad. Sci.</i> 67(1):305-12, September 1970. |
| 5. | 313 | 0 | 72 | 146 | 95 | Mueller, A.H. O(2,1) analysis of single-particle spectra at high energy. <i>Physical Review D</i> 2(12):2963-68, 15 December 1970. |
| *6. | 282 | 0 | 65 | 121 | 96 | Perutz, M.F. Stereochemistry of cooperative effects in haemoglobin. <i>Nature</i> 228(5273):726-39, 21 November 1970. |
| *7. | 276 | 1 | 39 | 94 | 142 | Laemmli, U.K. Cleavage of structural proteins during the assembly of the head of bacteriophage T4. <i>Nature</i> 227(5259):680-85, 15 August 1970. |
| *8. | 251 | 0 | 46 | 95 | 110 | Cuatrecasas, P. Protein purification by affinity chromatography; derivations of agarose and polyacrylamide beads. <i>J. Biol. Chem.</i> 245(12):3059-65, 25 June 1970. |
| 9. | 227 | 13 | 111 | 58 | 45 | Pearson, P.L., Borrow, M. & Vosa, C.G. Technique for identifying Y chromosomes in human interphase nuclei. <i>Nature</i> 226(5240):78-80, 4 April 1970. |
| 10. | 223 | 0 | 56 | 109 | 58 | Rasmussen, H. Cell communication, calcium ion, and cyclic adenosine monophosphate. <i>Science</i> 170(3956):404-12, 23 October 1970. |
| *11. | 218 | 0 | 71 | 75 | 72 | Pardue, M.L. & Gall, J.G. Chromosomal localization of mouse satellite DNA. <i>Science</i> 168(3937):1356-58, 12 June 1970. |
| 12. | 214 | 16 | 71 | 78 | 49 | Krugman, S. & Giles, J.P. Viral hepatitis; new light on an old disease. <i>J. Amer. Med. Assoc.</i> 212(6):1019-29, 11 May 1970. |
| 13. | 214 | 2 | 87 | 66 | 59 | Caspersson, T., Zech, L., Johansson, C. & Modest, E.J. Identification of human chromosomes by DNA-binding fluorescent agents. <i>Chromosoma</i> 30(2):215-27, 1970. |
| 14. | 204 | 16 | 76 | 81 | 31 | Sanders, J.K.M. & Williams, D.H. A shift reagent for use in nuclear magnetic resonance spectroscopy; a first-order spectrum of n-hexanol. <i>Chemical Communications</i> (7):422-23, 1970. |
| *15. | 196 | 25 | 44 | 61 | 66 | Roeder, R.G. & Rutter, W.J. Specific nucleolar and nucleoplasmic RNA polymerases. <i>Proc. Nat. Acad. Sci.</i> 65(3):675-82, March 1970. |
| *16. | 194 | 14 | 53 | 63 | 64 | Raff, M.C., Sternberg, M. & Taylor, R.B. Immunoglobulin determinants on the surface of mouse lymphoid cells. <i>Nature</i> 225(5232):553-54, 7 February 1970. |

| Rank | Citations | | | | | Bibliographical Data |
|------|------------------------|------|------|------|--------------------|---|
| | Total 1/70- 9/73 | 1970 | 1971 | 1972 | Jan.-Sept. 1973 | |
| 17. | 189 | 15 | 67 | 62 | 45 | Spiegelman, S., Burny, A., Das, M.R., Keydar, J., Schlom, J., Travnicek, M. & Watson, K. Characterization of the products of RNA-directed DNA polymerases in oncogenic RNA viruses. <i>Nature</i> 227(5258):563-67, 8 August 1970. |
| *18. | 189 | 0 | 41 | 79 | 69 | Pernis, B., Forni, L. & Amante, L. Immunoglobulin spots on the surface of rabbit lymphocytes. <i>J. Exp. Med.</i> 132(5):1001-18, November 1970. |
| 19. | 171 | 11 | 40 | 69 | 51 | Uretsky, N.J. & Iversen, L.L. Effects of 6-hydroxydopamine on catecholamine containing neurones in the rat brain. <i>J. Neurochem.</i> 17(2):269-78, 1970. |
| *20. | 164 | 0 | 47 | 66 | 51 | Bloom, E.D. & Gilman, F.J. Scaling, duality, and the behavior of resonances in inelastic electron-proton scattering. <i>Physical Review Letters</i> 25(16):1140-43, 19 October 1970. |
| 21. | 161 | 0 | 66 | 70 | 25 | Demarco, P.V., Elzey, T.K., Lewis, R.B. & Wenkert, E. Paramagnetic induced shifts in the proton magnetic resonance spectra of alcohols using Tris(dipivalomethanato)europium(III). <i>J. Am. Chem. Soc.</i> 92(19):5734-37, 23 September 1970. |
| 22. | 159 | 1 | 47 | 68 | 43 | Ashwell, M. & Work, T.S. The biogenesis of mitochondria. <i>Annu. Rev. Biochem.</i> 39:251-90, 1970. |
| 23. | 155 | 12 | 55 | 51 | 37 | Jones, K.W. Chromosomal and nuclear location of mouse satellite DNA in individual cells. <i>Nature</i> 225(5236):912-15, 7 March 1970. |
| 24. | 147 | 17 | 49 | 51 | 30 | Blumberg, B.S., Sutnick, A.I. & London, W.T. Australia antigen as a hepatitis virus; variation in host response. <i>Amer. J. Med</i> 48(1):1-8, January 1970. |
| 25. | 147 | 11 | 61 | 45 | 30 | Kessler, H. Detection of hindered rotation and inversion by NMR Spectroscopy. <i>Angew. Chem. Internat. Edit.</i> 9(3):219-35, 1970. |
| *26. | 144 | 28 | 38 | 42 | 36 | Kedinger, C., Gniazdowski, M., Mandel, J.L. Jr., Gissinger, F. & Chambon, P. α -Amanitin; a specific inhibitor of one of two DNA-dependent RNA polymerase activities from calf thymus. <i>Biochem. Biophys. Res. Comm.</i> 38(1):165-71, January 1970. |
| 27. | 140 | 24 | 51 | 40 | 25 | Smith, A.E. & Marcker, K.A. Cytoplasmic methionine transfer RNAs from eukaryotes. <i>Nature</i> 226(5246):607-10, 16 May 1970. |
| 28. | 136 | 0 | 47 | 59 | 30 | Lenard, J. Protein and glycolipid components of human erythrocyte membranes. <i>Biochemistry</i> 9(5):1129-1132, 3 March 1970. |
| | 129 | 24 | 44 | 43 | 18 | McDowell, F., Lee, J.E., Swift, T., Sweet, R.D., Ogsbury, J.S. & Kessler, J.T. Treatment of Parkinson's syndrome with L-dihydroxyphenylalanine (levodopa). <i>Ann. Int. Med.</i> 72(1):29-35, January 1970. |
| 30. | 126 | 0 | 62 | 48 | 16 | Gilman, F.J., Pumplun, J., Schwimmer, A. & Stodolsky, L. Helicity conservation in diffraction scattering. <i>Physics Letters</i> 31B(6):387-90, 16 March 1970. |

*In the case of these papers, if the number of Jan.-Sept. 73 citations is extrapolated to a full twelve months, their citation frequency is seen to be still on the rise. See item 3 among the references for possible significance of this continuing increase.