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Current Comments

The 1978 Articles Most Cited in 1978 and 1979. 2. Life Sciences

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Last week, we listed over 100 1978 physical sciences articles that were most cited in 1978-79.[1] This week, we cover the life sciences. These studies help to identify some of the fast-moving research fronts in science, as well as the newer methodologies.

The average paper in this week's study received 65 citations over a two year period. It received 12 of those citations in 1978 and 53 in 1979. In our study of the physical sciences papers, we found an average of 43 citations per paper.[1] Whether this difference in average citation rates reflects the greater size of the life sciences and biochemical literature, or whether it is due to other factors, needs further study.

The least-cited paper in this week's list received 43 citations. Since nine papers were each cited 43 times, we extended the list to the 103 papers listed in Figure 1, which follows this editorial. The most-cited paper received 192 citations.

Of the 27 journals represented in Table 1, *Proceedings of the National Academy of Sciences US* again accounts for more papers, 24, than any other journal. It has topped our life sciences journal list for several years.[2,3] *Nature* contributed 16 papers to the list, and *Cell* 13. These three journals together account for more than half of the papers.

The authors who produced the papers in this study came from the 86 institutions listed in Table 2. The US is represented by 54 institutions, the United Kingdom by nine, Japan, Switzerland, and Canada each by four. France, Belgium, Finland, and Sweden each account for two institutions, while the Federal Republic of Germany, Israel, and Poland each account for one. Without exception, the papers in Figure 1 were published in English.

Eleven papers are single-author works. Twenty papers have two authors, 19 have three, 17 have four, and 13 have five. Nine papers have six authors, seven have seven, three have eight, and four have nine authors.

Twenty-eight authors have more than one paper on the list. Of these, ten have three. They are: G.N. Callahan, W. Gilbert, R.B. Herberman, J. Klein, R. Korbut, P. Leder, S. Moncada, B.W. O'Malley, S.M. Tilghman, and R.M. Zinkernagel. The 18 authors who have two papers on the list are: A. Althage, D. Baltimore, H. Cantor, S. Cooper, R.K. Gershon, H.T. Holden, J. Hugenberger, P.M. Laduron, J.E. Leysen, L. McVay-Boudreau, K. Olden, F.W. Shen, J.G. Sutcliffe, D.C. Tiemeir, R. Tizard, S. Tonegawa, J.R. Vane, and K.M. Yamada.

As always, I must caution that the papers appearing in this study are not necessarily the "best," although they are undoubtedly important. Therefore, we have taken our usual step of dividing the list into subject areas and listing papers alphabetically within each area. We do this in hopes of discouraging irrelevant comparisons of individual citation rates.

Table 1: The 27 journals represented on the list of 1978 life sciences papers most cited in 1978-79. The numbers in parentheses are the impact factors for the journals. (Impact equals average number of citations received by articles published in that journal.) Data were taken from the 1978 *Journal Citation Reports*®, which is volume 13 of the *SCI*®. The figures at the right indicate the number of papers from each journal which appears on the list.

Proc. Nat. Acad. Sci. US (9.339)	24
Nature (5.409)	16
Cell (12.933)	13
J. Exp. Med. (9.834)	6
N. Engl. J. Med. (12.274)	6
J. Biol. Chem. (6.062)	5
Lancet (8.644)	4
Anal. Biochem. (2.309)	3
FEBS Lett. (3.004)	3
Science (5.927)	3
Biochim. Biophys. Acta (3.215)	2
Cancer Res. (3.904)	2
J. Immunol. (5.217)	2
Advan. Cancer Res. (10.650)	1
Ann. Intern. Med. (5.747)	1
Annu. Rev. Biochem. (29.525)	1
Biochem. Pharmacol. (2.508)	1
Biochemistry (4.914)	1
Brain Res. (4.067)	1
Brit. J. Pharmacol. (4.576)	1
Circulation (6.721)	1
Immunol. Rev.* (16.283)	1
Int. J. Cancer (4.776)	1
In Vitro (2.394)	1
J. Clin. Microbiol. (1.828)	1
Nucl. Acid. Res. (3.522)	1
Physiol. Rev. (17.314)	1

*Title changed from Transplantation Rev.

Table 2: The institutional affiliations of authors on the list. Institutions are in descending order of the number of papers produced. The number of authors from each institution is shown in parentheses.

National Institutes Health		18	(51)*
NCI	9 (30)*		
NIAMDD	2 (3)		
NICHHD	3 (13)		
NIDR	1 (1)		
NHLBI	1 (1)		
NIAID	1 (1)		
Blood Bank Department	1 (2)		
Harvard University and Medical School		11	(27)*
University California		9	(25)
San Francisco	4 (13)		
Los Angeles	3 (6)		
Irvine	1 (1)		
San Diego	1 (5)		
Yale		6	(18)
MIT		5	(13)
Baylor College Medicine		4	(14)
Stanford University		4	(15)*
MRC		3	(7)
Cambridge, UK	2 (5)		
London, UK	1 (2)		
Sloan-Kettering Institute for Cancer Research, NY		3	(8)
Southwestern Medical School, Dallas, TX		3	(6)
Scripps Clinic and Research Foundation, La Jolla, CA		3	(7)
University Wisconsin		3	(4)
Wellcome Research Labs., Beckenham, Kent, UK		3	(10)
Basel Institute Immunology, Switzerland		2	(6)
CNRS, France		2	(9)
INSERM, Fac. Med., Strasbourg	1 (5)		
Inst. Pasteur, Paris	1 (4)		
Cold Spring Harbor Lab., NY		2	(5)
Duke University Medical Center		2	(3)
Johns Hopkins University School Medicine		2	(5)
Janssen Pharmaceutica Research Labs., Beerse, Belgium		2	(7)
New England Medical Center, Boston, MA		2	(2)*
Osaka University, Fukushima, Japan		2	(3)
Rockefeller University, NY		2	(5)
SUNY, Stony Brook		2	(4)
Salk Institute, La Jolla, CA		2	(3)
Tufts University, Boston, MA		2	(2)*
University Florida		2	(3)
University Helsinki, Finland		2	(3)
Washington University, School Medicine, St. Louis, MO		2	(4)
ARC Institute Animal Physiology, Cambridge, UK		1	(2)
Albert Einstein School Medicine, NY		1	(1)
American Cancer Society		1	(1)*
American National Red Cross, Wash., DC		1	(2)
Boston University Medical Center		1	(3)
Brookhaven National Laboratory, Upton, NY		1	(1)
Burroughs Wellcome Co., Research Triangle Park, NC		1	(1)
Carnegie-Mellon University, Pittsburgh, PA		1	(4)
Case-Western Reserve School Medicine, Cleveland, OH		1	(1)
Center for Disease Control, Atlanta, GA		1	(7)
Children's Hospital Medical Center, Boston, MA		1	(2)
Columbia University College Physicians and Surgeons		1	(5)
Copernicus Academy Medicine, Cracow, Poland		1	(3)
Cornell University, Ithaca, NY		1	(1)*
CUNY		1	(1)
A.V. Davis Center for Behavioral Neurobiology, La Jolla, CA		1	(3)
FDA, Bethesda, MD		1	(3)
Georgetown University, Wash., DC		1	(2)
Hôpital Cantonal Universitaire, Lausanne, Switzerland		1	(3)
Hoffmann-La Roche, Nutley, NJ		1	(4)
Hokkaido University, Sapporo, Japan		1	(2)
Imperial Cancer Research Fund, London, UK		1	(5)*
Institut de Recherches Scientifiques sur le Cancer, Villejuif, France		1	(2)
Mayo Clinic Medical School, Rochester, MN		1	(2)
MRC, Ottawa, Canada		1	(3)
Methodist Hospital, Houston, TX		1	(1)

Northwestern University, Evanston, IL	1	(2)
Nakamiya Mental Hospital, Osaka, Japan	1	(1)
NYU School Medicine, NY	1	(1)
Osaka University, Tayonako, Japan	1	(2)
Squibb Research Inst., Princeton, NJ	1	(3)
Sidney Farber Cancer Institute, Boston, MA	1	(2)
University Aberdeen, UK	1	(2)
University Birmingham, UK	1	(2)
University British Columbia, Vancouver, Canada	1	(3)
University Cambridge, UK	1	(1)
University Colorado Medical Center, Denver	1	(2)
University Dundee, UK	1	(4)
University Geneva, Switzerland	1	(1)
University Ghent, Belgium	1	(9)
University Göteborg, Sweden	1	(8)
University Kuopio, Finland	1	(1)
University Laval, Quebec, Canada	1	(2)
University Manitoba, Winnipeg, Canada	1	(1)
University Michigan Hospital, Ann Arbor, MI	1	(1)*
University Pennsylvania, Wistar Institute of Anatomy and Biology, PA	1	(2)
University Southern Alabama	1	(1)
University Texas Health Sciences Center, Dallas, TX	1	(3)
University Utah, Salt Lake City, UT	1	(3)
University Warwick, Coventry, UK	1	(2)
University Washington, Seattle, WA	1	(3)
University Würzburg, FRG	1	(2)
University Zurich, Switzerland	1	(2)
Uppsala University, Sweden	1	(3)
Veterans Administration, Wadsworth Hospital Center, Los Angeles, CA	1	(2)
Veterans Administration Hospital, Boston, MA	1	(2)
Veterans Administration Hospital, Wash., DC	1	(2)
Weizmann Institute, Rehovoth, Israel	1	(1)

*One or more of these authors represents a second affiliation for a single author.

Such comparisons are valid only when we are identifying the milestone papers in various clusters or fields.[4,5]

The papers on our list fall into 17 subject categories: DNA and RNA research, immunology, virology and viral genetics, cytology, enzymology, neuropharmacology, prostaglandins, oncology, pathology, endocrinology and growth factors, immunogenetics, proteins, interferon, cardiovascular research, neurology, biochemical methodology, and pharmacology.

Nearly a quarter of the papers on the list, 23, are from DNA and RNA research. This is nearly the same proportion that we found in our study of the most-cited 1977 life sciences literature.[2] Included in this category are four of the top five most-cited articles on the list. The paper by W. Fiers and colleagues is second most-cited, and deals with the DNA mapping of simian virus 40 (SV40), a tumor-causing agent in monkeys. The third most-cited paper is G. Felsenfeld's review of the structure of chromatin, that part of the cell nucleus which carries the genes. The fourth and fifth most-cited papers, both by S. Tilghman and colleagues, describe the use of cell cloning to ascertain the structure of a particular mouse gene.

The field of immunology contributed 14 papers. As in our study of the 1977 life sciences papers,[2] much attention is focused on T-lymphocytes, or T-cells. T-cells are an important component of the body's defense against diseases because they have the ability to "recognize" antigens and to regulate the production of appropriate antibodies.

Eleven papers from virology and viral genetics appear on our list. This category includes the most-cited paper, that by V.B. Reddy and colleagues. Their article describes the nucleotide sequence of SV40 DNA. It should be mentioned that in addition to oncological research, SV40 is also popular for research into gene transplantation. Two other papers in this group, those by A.J. Berk and P.A. Sharp, and by L.V. Crawford and colleagues received more than 100 citations. Both of them deal with SV40.

There are six cytology papers. Most cited among them is E.D. Korn's review of the biochemical basis of cell motility. Three other papers in this group deal with various aspects of cell surface membranes.

Six papers are from the field of enzymology. The papers by R. Dabrowska and colleagues, and by K. Yagi and colleagues, discuss activation of the protein myosin by enzymes, which causes muscle contraction.

Six papers are from neuropharmacology. The two papers by J.E. Leysen and colleagues examine the manner in

which certain substances bind to neuroleptic receptors. Drugs that bind to neuroleptic receptors produce antipsychotic effects. Just one paper in this group deals directly with endorphins and enkephalins, endogenously produced opiates found in the brain and pituitary gland. In our study of the 1977 life sciences papers, there were 11 papers dealing with these substances.[2]

Prostaglandin research accounts for six papers. Prostaglandins are fatty acids which behave much like hormones. They are believed to be important in the regulation of cellular metabolism. A better understanding of the many kinds of prostaglandins may someday lead to improved treatments for asthma, cardiovascular disease, congenital heart disease, and several inflammatory diseases.

There are five papers from the field of oncology, the study of tumors. There are also five pathology papers, including two on Legionnaires' disease.

Four papers are from the field of endocrinology and growth factors. Most cited among them is J. Schlessinger and colleagues' study of insulin.

There are four immunogenetics papers. The one by S. Tonegawa and colleagues received 101 citations. That paper described the mapping of a mouse immunoglobin gene. Immunoglobin is a protein with antibody properties. Two other papers in this group deal with the genetics of immunoglobin production.

Research into proteins produced four papers. P. Greengard's paper on phosphorylated proteins, proteins which have had their chemical bonds broken by phosphoric acid, received 110 citations.

There are three papers on interferon, a naturally occurring defense against viral disease. As the article by T. Merigan and colleagues indicates, interferon may be helpful for treating viral infections in patients with cancer. The possible effectiveness of interferon against cancer itself has raised public expectations. Unfortunately, research in this area is hampered by a scarcity of interferon caused by incredible difficulties in extracting it from human tissues.

Cardiovascular research and neurology each contributed two papers to the list. One paper apiece came from the fields of biochemical methodology and pharmacology.

No doubt, most of the papers appearing in Figure 1 will continue to be highly cited as time passes. We recognize, however, that some important papers failed to make our list merely because they were published late in 1978. Therefore, in Figure 2, we have compiled an additional list of highly cited 1978 life sciences papers that would have made the list if we counted 1979 citations only.

We did not, as we did for the 1977 papers, hold up publication of this data to include those papers that turned up as a result of 1980 citations. Consequently, in the future we will expand these lists and report on selected papers from fields that, for one reason or another, are not adequately represented.

We have to date published lists of the most-cited articles for each year since 1970. This series of studies will continue, and we look forward to presenting the lists of the most-cited articles of 1979.

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3. ----------. The 1976 articles most cited in 1976 and 1977. Part 1. Life sciences. *Current Contents* (13):5-23, 26 March 1979.

4. ----------, ABCs of cluster mapping. Part 1. Most active fields in the life sciences in 1978. *Current Contents* (40):5-12, 6 October 1980.
5. ----------, ABCs of cluster mapping. Part 2. Most active fields in the physical sciences in 1978. *Current Contents* (41):5-12, 13 October 1980.

Figure 1: The 1978 life sciences articles most cited in 1978-79. The authors' addresses follow each citation. Journals are often ambiguous about addresses. When we could not tell which author was at which organization, we have simply given the addresses without linking them to specific authors.

DNA-RNA

78	79	Total Citations	Bibliographic Data
9	47	56	Alt F W, Kellems R E, Bertino J R & Schimke R T. **Selective multiplication of dihydrofolate reductase genes in methotrexate-resistant variants of cultured murine cells.** *J. Biol. Chem.* 253:1357-70, 1978. Stanford Univ., Dept. Biol. Sci., Stanford, CA.
0	56	56	Breathnach R, Benoist C, O'Hare K, Gannon F & Chambon P. **Ovalbumin gene: evidence for a leader sequence in mRNA and DNA sequences at the exon-intron boundaries.** *Proc. Nat. Acad. Sci. US* 75:4853-7, 1978. CNRS, INSERM, Inst. Chim. Biol., Fac. Med., Lab. Genet. Molec., Strasbourg, France.
8	40	48	Calos M P,[1] Johnsrud L[1] & Miller J H.[2] **DNA sequence at the integration sites of the insertion element IS1.** *Cell* 13:411-8, 1978. 1. Harvard Univ., Biol. Labs., Cambridge, MA. 2. Univ. Geneva, Dept. Molec. Biol., Geneva, Switzerland.
6	44	50	Dugaiczyk A, Woo S L C, Lai E C, Mace M L, McReynolds L & O'Malley B W. **The natural ovalbumin gene contains seven intervening sequences.** *Nature* 274:328-35, 1978. Baylor Coll. Med., Dept. Cell Biol., Houston, TX.
45	138	183	Felsenfeld G. **Chromatin.** *Nature* 271:115-22, 1978. NIH, NIAMDD, Lab. Molec. Biol., Bethesda, MD.
32	152	184	Fiers W, Contreras R, Haegeman G, Rogiers R, Van de Voorde A, Van Heuverswyn H, Van Herreweghe J, Volckaert G & Ysebaert M. **Complete nucleotide sequence of SV40 DNA.** *Nature* 273:113-20, 1978. Univ. Ghent, Lab. Molec. Biol., Belgium.
20	67	87	Gilbert W. **Why genes in pieces?** *Nature* 271:501, 1978. Amer. Cancer Soc., New York, NY & Harvard Univ., Dept. Molec. Biol., Cambridge, MA.
6	41	47	Grindley N D F. **IS1 insertion generates duplication of a nine base pair sequence at its target site.** *Cell* 13:419-26, 1978. Yale Univ., Dept. Molec. Biophys. & Biochem., New Haven, CT.
12	58	70	Hagenbuchle O,[1] Santer M,[1] Steitz J A[1] & Mans R J.[2] **Conservation of the primary structure at the 3' end of the 18S rRNA from eucaryotic cells.** *Cell* 13:551-63, 1978. 1. Yale Univ., Dept. Molec. Biophys. & Biochem., New Haven, CT. 2. Univ. Florida, Dept. Biochem., Gainesville, FL.
15	53	68	Highfield P E & Ellis R J. **Synthesis and transport of the small subunit of chloroplast ribulose bisphosphate carboxylase.** *Nature* 271:420-4, 1978. Univ. Warwick, Dept. Biol. Sci., Coventry, UK.
10	58	68	Knapp G, Beckmann J S, Johnson P F, Fuhrman S A & Abelson J. **Transcription and processing of intervening sequences in yeast tRNA genes.** *Cell* 14:221-36, 1978. Univ. California, San Diego, Depts. Chem. & Biol., La Jolla, CA.
0	51	51	Konkel D A, Tilghman S M & Leder P. **The sequence of the chromosomal mouse β-globin major gene: homologies in capping, splicing and poly(A) sites.** *Cell* 15:1125-32, 1978. NIH, NICHHD, Lab. Molec. Genet., Bethesda, MD.
15	61	76	McReynolds L,[1] O'Malley B W,[1] Nisbet A D,[2] Fothergill J E,[2] Givol D,[3] Fields S,[4] Robertson M[4] & Brownlee G G.[4] **Sequence of chicken ovalbumin mRNA.** *Nature* 273:723-8, 1978. 1. Baylor Coll. Med., Houston, TX. 2. Univ. Aberdeen, Dept. Biochem., Aberdeen, UK. 3. Weizmann Inst., Rehovoth, Israel. 4. MRC Lab. Molec. Biol., Cambridge, UK.
1	46	47	Roop D R, Nordstrom J L, Tsai S Y, Tsai M J & O'Malley B W. **Transcription of structural and intervening sequences in the ovalbumin gene and identification of potential ovalbumin mRNA precursors.** *Cell* 15:671-85, 1978. Baylor Coll. Med., Dept. Cell Biol., Houston, TX.
15	51	66	Rosenberg M,[1] Court D,[1] Shimatake H,[1] Brady C[1] & Wulff D L.[2] **The relationship between function and DNA sequence in an intercistronic regulatory region in phage λ.** *Nature* 272:414-23, 1978. 1. NIH, NCI, Lab. Molec. Biol., Bethesda, MD. 2. Univ. California, Dept. Biol. & Biochem., Irvine, CA.
13	32	45	Rowen L & Kornberg A. **Primase, the *dnaG* protein of *Escherichia coli*.** *J. Biol. Chem.* 253:758-64, 1978. Stanford Univ. Sch. Med., Dept. Biochem., Stanford, CA.
22	81	103	Sanger F & Coulson A R. **The use of thin acrylamide gels for DNA sequencing.** *FEBS Lett.* 87:107-10, 1978. MRC Lab. Molec. Biol., Cambridge, UK.
3	50	53	Sutcliffe J G. **Nucleotide sequence of the ampicillin resistance gene of *Escherichia coli* plasmid pBR322.** *Proc. Nat. Acad. Sci. US* 75:3737-41, 1978. Harvard Univ., Biol. Labs., Cambridge, MA.
1	49	50	Sutcliffe J G. **pBR322 restriction map derived from the DNA sequence: accurate DNA size markers up to 4361 nucleotide pairs long.** *Nucl. Acid. Res.* 5:2721-41, 1978. Harvard Biol. Labs., Cambridge, MA.
32	105	137	Tilghman S M,[1] Curtis P J,[2] Tiemeier D C,[1] Leder P[1] & Weissmann C.[2] **The intervening sequence of a mouse β-globin gene is transcribed within the 15S β-globin mRNA precursor.** *Proc. Nat. Acad. Sci. US* 75:1309-13, 1978. 1. NIH, NICHHD, Lab. Molec. Genet., Bethesda, MD. 2. Univ. Zurich, Inst. Molec. Biol., Zurich, Switzerland.
54	90	144	Tilghman S M, Tiemeier D C, Seidman J G, Peterlin B M, Sullivan M, Maizel J V & Leder P. **Intervening sequence of DNA identified in the structural portion of a mouse β-globin gene.** *Proc. Nat. Acad. Sci. US* 75:725-9, 1978. NIH, NICHHD, Lab. Molec. Genet., Bethesda, MD.

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Immunology

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Virology/Viral Genetics

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Figure 2: The 1978 life sciences articles which are among the 100 most cited in 1979, and which do not appear in Figure 1.

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