Essays of an Information Scientist, Vol:6, p.63-73, 1983 Current Contents, #10, p.5-15, March 7, 1983

Current Comments®

The 1980 Articles Most Cited in 1980 and 1981. 1. Life Sciences

Number 10 March 7, 1983

In this essay, we identify the life sciences articles published in 1980 that received the most citations in 1980 and 1981. We have studied papers that became highly cited soon after publication for several years now.[1-3] Papers that receive an immediate burst of citations usually point to "hot spots" of science. In the weeks to come, we will follow up this essay with separate reports on the most-cited 1980 papers in the physical and chemical sciences.

Figure 1 lists 105 articles included in this study, and the number of citations they received in 1980 and 1981 are shown. We try to limit the number of papers to about 100 because we can't provide more space in which to present these studies of most-cited papers. The least-cited paper received 52 citations, and since seven papers were each cited 52 times we extended the list to 105 papers.

The papers listed in Figure 1 are interesting because their impact was *immediate*. The average paper in this study received 82 citations, 15 in 1980 and 67 in 1981. The most-cited paper received 345 citations. Keep in mind that most of the 4,000,000 papers and books cited in *Science Citation Index®* (*SCI®*) each year receive about one or two citations.

The articles fall into 17 broad subject areas, and they are arranged in alphabetical order by first author within each category. We do this to discourage invidious comparisons based on individual citation rates. All of these papers have had a significant impact on their fields. But we are not in a position to judge if certain papers are "better" relative to any other. And, of course, many other papers will eventually prove to have equal, or even greater, impact in later years due to a variety of factors.

Eighty-three of the 105 articles in this study are already included as "core" documents for *ISI/BIOMED®* research fronts. They are indicated by the research front numbers following the bibliographic information in Figure 1. A research front is created when a group of current papers cite one or more papers identified as the core for that topic. The majority of the papers in Figure 1 have *already* been incorporated into the core literature of their fields.

Table 1 lists the names of the research fronts that include two or more papers in this study as *core* documents. A complete list of research front names can be found in the *Index to Research Fronts in ISI/BIOMED*.[4] The numbers in column A correspond to the research front numbers following the bibliographic information in Figure 1. The names are derived from the words and phrases most frequently used in the titles of research front articles that cite the core documents. In fact, the research front names are an alternative way of classifying the papers in this study. They give you a clearer idea of the papers' cognitive content than classification by broad disciplinary categories.

There are a variety of reasons why 22 of the 105 papers in this study do not appear as core papers in any of the thousands of research clusters we identify each year. The most obvious reason

Figure 1: The 1980 life sciences articles most cited in 1980-1981. The authors' addresses follow each citation. Code numbers indicate the *ISI/BIOMED®* research front specialties for which these are *core* papers. Asterisked code numbers indicate papers included in research fronts as *citing* papers. A=number of citations in 1980. B=number of citations in 1981. C=total number of citations for 1980 and 1981.

A	B	C	Bibliographic Data
			Molecular Genetics—Gene Expression and Regulation
15	48	63	Alestrom P, Akusjärvi G, Perricaudet M, Mathews M B, Klessig D F & Pettersson U. **The gene for polypeptide IX of adenovirus type-2 and its unspliced messenger RNA.** *Cell* 19:671-81, 1980. Univ. Uppsala, Biomed. Ctr., Uppsala, Sweden; INSERM, Unit 184, Gen. Genet.; CNRS Inst. Pasteur, Paris, France; Cold Spring Harbor Lab., Cold Spring Harbor, NY. 81-0081
31	68	99	Bogenhagen D F, Sakonju S & Brown D D. **A control region in the center of the 5S RNA gene directs specific initiation of transcription: II. The 3' border of the region.** *Cell* 19:27-35, 1980. Carnegie Inst. Washington, Dept. Embryol., Baltimore, MD. 80-0493; 81-0002
2	58	60	Corden J, Wasylyk B, Buchwalder A, Sassone-Corsi P, Kédinger C & Chambon P. **Promoter sequences of eukaryotic protein-coding genes.** *Science* 209:1406-14, 1980. CNRS, Lab. Genet. Mol., Paris, Inst. Chim. Biol., Facult. Med., Strasbourg; INSERM, Unit 184, Biol. Mol. & Gen. Genet., Paris, France. 81-0397
9	47	56	Craig N L & Roberts J W. ***E. coli* recA protein-directed cleavage of phage λ repressor requires polynucleotide.** *Nature* 283:26-30, 1980. Cornell Univ., Dept. Biochem., Mol. Cell Biol., Ithaca, NY. 81-0108
16	55	71	Engelke D R, Ng S-Y, Shastry B S & Roeder R G. **Specific interaction of a purified transcription factor with an internal control region of 5S RNA genes.** *Cell* 19:717-28, 1980. Washington Univ., Sch. Med., St. Louis, MO. 80-0493; 81-0002
14	78	92	Grosschedl R & Birnstiel M L. **Identification of regulatory sequences in the prelude sequences of an H2A histone gene by the study of specific deletion mutants *in vivo*.** *Proc. Nat. Acad. Sci. US—Biol. Sci.* 77:1432-6, 1980. Univ. Zurich, Inst. Mol. Biol., Zurich, Switzerland. 80-0373; 81-0397
56	151	207	Lerner M R, Boyle J A, Mount S M, Wolin S L & Steitz J A. **Are snRNPs involved in splicing?** *Nature* 283:220-4, 1980. Yale Univ., Dept. Mol. Biophys. Biochem., New Haven, CT. 80-2334; 81-0002
13	40	53	Liu L F, Liu C-C & Alberts B M. **Type II DNA topoisomerases: enzymes that can unknot a topologically knotted DNA molecule via a reversible double-strand break.** *Cell* 19:697-707, 1980. Univ. Calif., Dept. Biochem. Biophys., San Francisco, CA. 80-0462; 81-0211
7	70	77	Manley J L, Fire A F, Cano A, Sharp P A & Gefter M L. **DNA-dependent transcription of adenovirus genes in a soluble whole-cell extract.** *Proc. Nat. Acad. Sci. US—Biol. Sci.* 77:3855-9, 1980. Mass. Inst. Technol., Ctr. Cancer Res. & Dept. Biol., Cambridge, MA. 81-2600
14	76	90	Rogers J & Wall R. **A mechanism for RNA splicing.** *Proc. Nat. Acad. Sci. US—Biol. Sci.* 77:1877-9, 1980. Univ. Calif., Sch. Med., Los Angeles, CA. 80-2334; 81-0002
35	83	118	Sakonju S, Bogenhagen D F & Brown D D. **A control region in the center of the 5S RNA gene directs specific initiation of transcription: I. The 5' border of the region.** *Cell* 19:13-25, 1980. Carnegie Inst. Washington, Dept. Embryol., Baltimore, MD. 80-0493; 81-0002
7	55	62	Siebenlist U, Simpson R B & Gilbert W. **E. coli RNA polymerase interacts homologously with two different promoters.** *Cell* 20:269-81, 1980. Harvard Univ., Biol. Labs., Cambridge, MA. *80-2179
4	64	68	Wasylyk B, Kédinger C, Corden J, Brison O & Chambon P. **Specific *in vitro* initiation of transcription on conalbumin and ovalbumin genes and comparison with adenovirus-2 early and late genes.** *Nature* 285:367-73, 1980. CNRS, Lab. Genet. Mol., Paris, Inst. Chim. Biol., Facult. Med., Strasbourg; INSERM, Unit 184, Biol. Mol. & Gen. Genet., Paris, France. 81-2600
26	58	84	Weisbrod S, Groudine M & Weintraub H. **Interaction of HMG 14 and 17 with actively transcribed genes.** *Cell* 19:289-301, 1980. Hutchinson Cancer Ctr., Div. Genet., Seattle, WA. 81-0112
			Molecular Genetics—Nucleic Acid Structure
21	67	88	Arnott S, Chandrasekaran R, Birdsall D L, Leslie A G W & Ratliff R L. **Left-handed DNA helices.** *Nature* 283:743-5, 1980. Purdue Univ., Dept. Biol. Sci., West Lafayette, IN. 80-0265; 81-0287
30	195	225	Bachmann B J & Low K B. **Linkage map of *Escherichia coli* K-12, edition 6.** *Microbiol. Rev.* 44:1-56, 1980. Yale Univ., Sch. Med., New Haven, CT. *81-0345
15	41	56	Bell G I, Pictet R L, Rutter W J, Cordell B, Tischer E & Goodman H M. **Sequence of the human insulin gene.** *Nature* 284:26-32, 1980. Univ. Calif., Dept. Biochem. Biophys. & Howard Hughes Med. Inst., San Francisco, CA. 80-0518
23	80	103	Benoist C, O'Hare K, Breathnach R & Chambon P. **The ovalbumin gene—sequence of putative control regions.** *Nucl. Acids Res.* 8:127-42, 1980. CNRS, Lab. Genet. Mol., Paris, Inst. Chim. Biol., Facult. Med., Strasbourg; INSERM, Unit 184, Biol. Mol. & Gen. Genet., Paris, France. 80-0373
16	50	66	Brosius J, Dull T J & Noller H F. **Complete nucleotide sequence of a 23S ribosomal RNA gene from *Escherichia coli*.** *Proc. Nat. Acad. Sci. US—Biol. Sci.* 77:201-4, 1980. Univ. Calif., Thimann Labs., Santa Cruz, CA. 81-0900
8	120	128	Calos M P & Miller J H. **Transposable elements.** *Cell* 20:579-95, 1980. Univ. Geneva, Dept. Mol. Biol., Geneva, Switzerland. *81-0295
19	39	58	Cozzarelli N R. **DNA gyrase and the supercoiling of DNA.** *Science* 207:953-60, 1980. Univ. Chicago, Dept. Biochem., Chicago, IL. 80-0462; 81-0211
1	51	52	Drew H, Takano T, Tanaka S, Itakura K & Dickerson R E. **High-salt d(CpGpCpG), a left-handed Z', DNA double helix.** *Nature* 286:567-73, 1980. Calif. Inst. Technol., Div. Chem. & Chem. Eng., Pasadena; City of Hope Nat. Med. Ctr., Duarte, CA. 81-0287

A	B	C	Bibliographic Data
			Molecular Genetics—Nucleic Acid Structure (continued)
19	73	92	Jelinek W R, Toomey T P, Leinwand L, Duncan C H, Biro P A, Choudary P V, Weissman S M, Rubin C M, Houck C M, Deininger P L & Schmid C W. **Ubiquitous, interspersed repeated sequences in mammalian genomes.** *Proc. Nat. Acad. Sci. US—Biol. Sci.* 77:1398-402, 1980. Rockefeller Univ., New York, NY; Yale Univ., Sch. Med., New Haven, CT; Univ. Calif., Dept. Chem., Davis; Univ. Calif., Dept. Pediat., La Jolla, CA. 80-0359; 81-0557
2	53	55	Long E O & Dawid I B. **Repeated genes in eukaryotes.** *Annu. Rev. Biochem.* 49:727-64, 1980. NIH, NCI, Bethesda, MD. *81-0002
6	79	85	McGhee J D & Felsenfeld G. **Nucleosome structure.** *Annu. Rev. Biochem.* 49:1115-56, 1980. NIH, NIAMDD, Bethesda, MD. *81-0141
			Molecular Genetics—Globin Gene Expression
7	87	94	Efstratiadis A, Posakony J W, Maniatis T, Lawn R M, O'Connell C, Spritz R A, DeRiel J K, Forget B G, Weissman S M, Slightom J L, Blechl A E, Smithies O, Baralle F E, Shoulders C C & Proudfoot N J. **The structure and evolution of the human β-globin gene family.** *Cell* 21:653-68, 1980. Harvard Univ., Sch. Med., Boston, MA; Calif. Inst. Technol., Div. Biol., Pasadena, CA; Yale Univ., Sch. Med., New Haven, CT; Univ. Wisconsin, Lab. Genet., Madison, WI; MRC Lab. Mol. Biol., Cambridge, UK. *81-0428
24	78	102	Fritsch E F, Lawn R M & Maniatis T. **Molecular cloning and characterization of the human β-like globin gene cluster.** *Cell* 19:959-72, 1980. Calif. Inst. Technol., Div. Biol., Pasadena, CA. 80-0359; 81-1837
22	75	97	Lauer J, Shen C-K J & Maniatis T. **The chromosomal arrangement of human α-like globin genes: sequence homology and α-globin gene deletions.** *Cell* 20:119-30, 1980. Calif. Inst. Technol., Div. Biol., Pasadena, CA. 80-0359; 81-1837
8	58	66	van der Ploeg L H T & Flavell R A. **DNA methylation in the human γδβ-globin locus in erythroid and nonerythroid tissues.** *Cell* 19:947-58, 1980. Univ. Amsterdam, Jan Swammerdam Inst., Amsterdam, Netherlands. 81-0684
5	49	54	Slightom J L, Blechl A E & Smithies O. **Human fetal Gγ- and Aγ-globin genes: complete nucleotide sequences suggest that DNA can be exchanged between these duplicated genes.** *Cell* 21:627-38, 1980. Univ. Wisconsin, Lab. Genet., Madison, WI. *81-0428
			Molecular Genetics—Selfish Genes
11	47	58	Doolittle W F & Sapienza C. **Selfish genes, the phenotype paradigm and genome evolution.** *Nature* 284:601-3, 1980. Dalhousie Univ., Dept. Biochem., Halifax, Canada. 81-1554
14	50	64	Orgel L E & Crick F H C. **Selfish DNA: the ultimate parasite.** *Nature* 284:604-7, 1980. Salk Inst. Biol. Studies, San Diego, CA. 81-1554
			Immunology
12	60	72	Breard J, Reinherz E L, Kung P C, Goldstein G & Schlossman S F. **A monoclonal antibody reactive with human peripheral blood monocytes.** *J. Immunol.* 124:1943-8, 1980. Harvard Univ., Sch. Med.; Sidney Farber Cancer Inst., Boston, MA; Ortho Pharmaceut. Corp., Div. Immunosci., Raritan, NJ. *81-1705
13	41	54	Goodwin J S & Webb D R. **Regulation of the immune response by prostaglandins.** *Clin. Immunol. Immunopathol.* 15:106-22, 1980. Univ. New Mexico, Sch. Med., Albuquerque, NM; Roche Inst. Mol. Biol., Nutley, NJ. *81-0164
11	42	53	Janossy G, Hoffbrand A V, Greaves M F, Ganeshaguru K, Pain C, Bradstock K F, Prentice H G, Kay H E M & Lister T A. **Terminal transferase enzyme assay and immunological membrane markers in the diagnosis of leukaemia: a multiparameter analysis of 300 cases.** *Brit. J. Haematol.* 44:221-34, 1980. Royal Free Hosp., Depts. Haematol. & Immunol.; Imperial Cancer Res. Fund, Membr. Immunol. Lab., London; Royal Marsden Hosp., Dept. Clin. Pathol. & MRC Leukaemia Trials Office, Sutton; St. Bartholomew's Hosp., ICRF Med. Oncol. Unit, London, UK. *81-0425
13	45	58	Larsson E-L, Iscove N N & Coutinho A. **Two distinct factors are required for induction of T-cell growth.** *Nature* 283:664-6, 1980. Univ. Umeå, Dept. Immunol., Umeå, Sweden; Basel Inst. Immunol., Basel, Switzerland. 80-0206; 81-2511
14	91	105	Reinherz E L, Kung P C, Goldstein G & Schlossman S F. **A monoclonal antibody reactive with the human cytotoxic/suppressor T cell subset previously defined by a heteroantiserum termed TH_2.** *J. Immunol.* 124:1301-7, 1980. Harvard Univ., Sch. Med.; Sidney Farber Cancer Inst., Div. Tumor Immunol., Boston, MA; Ortho Pharmaceut. Corp., Div. Immunosci., Raritan, NJ. 80-1573; 81-2489
22	131	153	Reinherz E L, Kung P C, Goldstein G, Levey R H & Schlossman S F. **Discrete stages of human intrathymic differentiation: analysis of normal thymocytes and leukemic lymphoblasts of T-cell lineage.** *Proc. Nat. Acad. Sci. US—Biol. Sci.* 77:1588-92, 1980. Harvard Univ., Sch. Med.; Children's Hosp. Med. Ctr.; Sidney Farber Cancer Inst., Div. Tumor Immunol., Boston, MA; Ortho Pharmaceut. Corp., Div. Immunosci., Raritan, NJ. 80-1573; 81-2489
18	102	120	Reinherz E L, Moretta L, Roper M, Breard J M, Mingari M C, Cooper M D & Schlossman S F. **Human T lymphocyte subpopulations defined by Fc receptors and monoclonal antibodies.** *J. Exp. Med.* 151:969-74, 1980. Harvard Univ., Sch. Med.; Sidney Farber Cancer Inst., Div. Tumor Immunol., Boston, MA; Univ. Genoa, Inst. Microbiol., Genoa, Italy; Univ. Alabama, Lurleen B. Wallace Tumor Inst., Birmingham, AL. *81-1705
2	73	75	Reinherz E L & Schlossman S F. **Current concepts in immunology.** *N. Engl. J. Med.* 303:370-3, 1980. Harvard Univ., Sch. Med.; Sidney Farber Cancer Inst., Div. Tumor Immunol., Boston, MA. *81-1705

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12 97 109 Reinherz E L & Schlossman S F. **The differentiation and function of human T lymphocytes.** *Cell* 19:821-7, 1980. Harvard Univ., Sch. Med.; Sidney Farber Cancer Inst., Div. Tumor Immunol., Boston, MA. *81-1705

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Virology, Viral Oncology

6 60 66 Collett M S, Purchio A F & Erikson R L. **Avian sarcoma virus-transforming protein, $pp60^{src}$ shows protein kinase activity specific for tyrosine.** *Nature* 285:167-9, 1980. Univ. Colorado, Sch. Med., Denver, CO. 81-0018

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Cell Biology, Physiology

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Leukotrienes

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Neurobiology

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Interferon

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A	B	C	Bibliographic Data
			Interferon (continued)
30	47	77	Knight E, Hunkapiller M W, Korant B D, Hardy R W F & Hood L E. **Human fibroblast interferon: amino acid analysis and amino terminal amino acid sequence.** *Science* 207:525-6, 1980. E.I. du Pont de Nemours & Co., Ctr. Res. Develop. Dept., Wilmington, DE; Calif. Inst. Technol., Div. Biol., Pasadena, CA. 80-0603; 81-0136
22	65	87	Nagata S, Taira H, Hall A, Johnsrud L, Streuli M, Ecsödi J, Boll W, Cantell K & Weissmann C. **Synthesis in *E. coli* of a polypeptide with human leukocyte interferon activity.** *Nature* 284:316-20, 1980. Univ. Zurich, Inst. Mol. Biol., Zurich, Switzerland; Ctr. Publ. Hlth. Lab., Helsinki, Finland. 80-0603; 81-0136
11	41	52	Taniguchi T, Mantei N, Schwarzstein M, Nagata S, Muramatsu M & Weissmann C. **Human leukocyte and fibroblast interferons are structurally related.** *Nature* 285:547-9, 1980. Japanese Fdn. Cancer Res., Cancer Inst., Tokyo, Japan; Univ. Zurich, Inst. Mol. Biol., Zurich, Switzerland. 81-0136
27	38	65	Zoon K C, Smith M E, Bridgen P J, Anfinsen C B, Hunkapiller M W & Hood L E. **Amino terminal sequence of the major component of human lymphoblastoid interferon.** *Science* 207:527-8, 1980. NIH, NIAMDD, Bethesda, MD; Calif. Inst. Technol., Div. Biol., Pasadena, CA. 80-0603; 81-0136
			Pharmacology
5	48	53	Antman E, Muller J, Goldberg S, MacAlpin R, Rubenfire M, Tabatznik B, Liang C-S, Heupler F, Achuff S, Reichek N, Geltman E, Kerin N Z, Neff R K & Braunwald E. **Nifedipine therapy for coronary-artery spasm.** *N. Engl. J. Med.* 302:1269-73, 1980. Brigham & Women's Hosp.; Harvard Univ., Sch. Med. & Sch. Publ. Hlth., Boston, MA. 81-0247
6	51	57	Klotz U & Reimann I. **Delayed clearance of diazepam due to cimetidine.** *N. Engl. J. Med.* 302:1012-4, 1980. Dr. Margarete Fischer-Bosch Inst. Klin. Pharmakol., Stuttgart, FRG. 81-1507
17	51	68	Powles R L, Clink H M, Spence D, Morgenstern G, Watson J G, Selby P J, Woods M, Barrett A, Jameson B, Sloane J, Lawler S D, Kay H E M, Lawson D, McElwain T J & Alexander P. **Cyclosporin A to prevent graft-versus-host disease in man after allogeneic bone-marrow transplantation.** *Lancet* 1:327-9, 1980. Inst. Cancer Res., Leukaemia Unit; Royal Marsden Hosp., Sutton, UK. 81-0664
18	39	57	Priebe H J, Skillman J J, Bushnell L S, Long P C & Silen W. **Antacid versus cimetidine in preventing acute gastrointestinal bleeding.** *N. Engl. J. Med.* 302:426-30, 1980. Harvard Univ., Sch. Med.; Beth Israel Hosp., Dept. Surg., Boston, MA. 81-2114
23	74	97	Tallman J F, Paul S M, Skolnick P & Gallager D W. **Receptors for the age of anxiety: pharmacology of the benzodiazepines.** *Science* 207:274-81, 1980. NIH, NIMH & NIAMDD, Bethesda, MD. *81-0301
			Calmodulin
88	257	345	Cheung W Y. **Calmodulin plays a pivotal role in cellular regulation.** *Science* 207:19-27, 1980. St. Jude Children's Research Hospital, Memphis, TN. 81-1181
11	99	110	Klee C B, Crouch T H & Richman P G. **Calmodulin.** *Annu. Rev. Biochem.* 49:489-515, 1980. NIH, NCI, Bethesda, MD. 81-1181
13	133	146	Means A R & Dedman J R. **Calmodulin—an intracellular calcium receptor.** *Nature* 285:73-7, 1980. Baylor Coll. Med., Dept. Cell Biol., Houston, TX. 81-1181
23	55	78	Watterson D M, Sharief F & Vanaman T C. **The complete amino acid sequence of the Ca^{2+}-dependent modulator protein (calmodulin) of bovine brain.** *J. Biol. Chem.* 255:962-75, 1980. Duke Univ. Med. Ctr., Durham, NC. 81-1458
			Endocrinology
21	69	90	Davies P J A, Davies D R, Levitzki A, Maxfield F R, Milhaud P, Willingham M C & Pastan I H. **Transglutaminase is essential in receptor-mediated endocytosis of α_2-macroglobulin and polypeptide hormones.** *Nature* 283:162-7, 1980. NIH, NCI, Bethesda, MD. 80-0196; 81-1431
21	54	75	Pradayrol L, Jörnvall H, Mutt V & Ribet A. **N-terminally extended somatostatin: the primary structure of somatostatin-28.** *FEBS Lett.* 109:55-8, 1980. Karolinska Inst., Depts. Chem. I & Biochem. II, Stockholm, Sweden; INSERM, Paris, France. 80-0246; 81-0869
31	131	162	Rodbell M. **The role of hormone receptors and GTP-regulatory proteins in membrane transduction.** *Nature* 284:17-22, 1980. NIH, NIAMDD, Bethesda, MD. *81-0690
2	55	57	Ross E M & Gilman A G. **Biochemical properties of hormone-sensitive adenylate cyclase.** *Annu. Rev. Biochem.* 49:533-64, 1980. Univ. Virginia, Sch. Med., Charlottesville, VA. *81-0690
			Bacteriology
4	53	57	Fox G E, Stackebrandt E, Hespell R B, Gibson J, Maniloff J, Dyer T A, Wolfe R S, Balch W E, Tanner R S, Magrum L J, Zablen L B, Blakemore R, Gupta R, Bonen L, Lewis B J, Stahl D A, Luehrsen K R, Chen K N & Woese C R. **The phylogeny of prokaryotes.** *Science* 209:457-63, 1980. Univ. Illinois, Depts. Genet. Develop., Dairy Sci. & Microbiol., Urbana, IL; Univ. Houston, Dept. Biophys. Sci., Houston, TX; Tech. Univ. Munich, Dept. Microbiol., Munich, FRG; Cornell Univ., Sect. Biochem. Mol. Cell. Biol., Ithaca, NY; Univ. Rochester Med. Ctr., Rochester, NY; A.R.C. Plant Breeding Inst., Cambridge, UK; Univ. New Hampshire, Dept. Microbiol., Durham, NH; Dalhousie Univ., Dept. Biochem., Halifax, Canada; Nat. Jewish Hosp., Denver, CO; Stanford Univ. Med. Ctr., Stanford, CA. *80-2209

A	B	C	Bibliographic Data
			Bacteriology (continued)
14	77	91	Skerman V B D, McGowan V & Sneath P H A. **Approved lists of bacterial names.** *Int. J. Syst. Bact.* 30:225-420, 1980. Univ. Queensland, Dept. Microbiol., St. Lucia, Australia; Univ. Leicester, MRC Microbiol. System. Unit, Leicester, UK. 81-2506
5	53	58	Twigg A J & Sherratt D. **Trans-complementable copy-number mutants of plasmid ColE1.** *Nature* 283:216-8, 1980. Univ. Sussex, Sch. Biol. Sci., Brighton, UK.
			Biochemistry
6	70	76	Bornstein P & Sage H. **Structurally distinct collagen types.** *Annu. Rev. Biochem.* 49:957-1003, 1980. Univ. Washington, Depts. Biochem. & Med., Seattle, WA. *81-0594
6	46	52	Little J W, Edmiston S H, Pacelli L Z & Mount D W. **Cleavage of the *Escherichia-coli lex A* protein by the *recA* protease.** *Proc. Nat. Acad. Sci. US—Biol. Sci.* 77:3225-9, 1980. Univ. Arizona, Sch. Med., Tucson, AZ. 81-0108
8	51	59	Pearlstein E, Gold L I & Garcia-Pardo A. **Fibronectin: a review of its structure and biological activity.** *Mol. Cell. Biochem.* 29:103-28, 1980. New York Univ., Med. Ctr., New York, NY. *81-0125
			Oncology
9	51	60	Driedger P E & Blumberg P M. **Specific binding of phorbol ester tumor promoters.** *Proc. Nat. Acad. Sci. US—Biol. Sci.* 77:567-71, 1980. Harvard Univ., Sch. Med., Boston, MA. 81-0945
20	67	87	Poste G & Fidler I J. **The pathogenesis of cancer metastasis.** *Nature* 283:139-46, 1980. Roswell Park Memorial Inst., Dept. Exp. Pathol., Buffalo, NY; NIH, NCI, Frederick Cancer Res. Ctr., Frederick, MD. 81-1768
8	47	55	Talmadge J E, Meyers K M, Prieur D J & Starkey J R. **Role of NK cells in tumour growth and metastasis in *beige* mice.** *Nature* 284:622-6, 1980. Washington State Univ., Dept. Vet. Microbiol. Pathol. & Dept. Vet. Compar. Anat. Pharmacol. Physiol., Pullman, WA. 81-1214

would be the "uniqueness" of a paper. That is, other papers in the same field may not yet have reached the required minimum citation threshold to appear in a cluster. For more on ISI®'s co-citation clustering methods, see my earlier essays.[5]

However, all but one of these 22 papers do appear as *citing* papers in *ISI/BIOMED* research fronts. They are indicated by the asterisked research front numbers in Figure 1. Table 2 lists the names of these research fronts. Undoubtedly, when we do the 1983 edition of *ISI/BIOMED*, these papers will also be part of the core document descriptions.

Only four of the articles in Figure 1 are single-author works. This is the lowest number of single-author works since we began this series in 1970. For example, the number of single-author works in 1977 was eight;[1] 11 in 1978;[2] and seven in 1979.[3] These data reflect the well-known fact that science is becoming an increasingly collaborative enterprise.

Twenty-seven papers in Figure 1 list two authors, 23 have three, 14 have four, and 17 have five authors. Seven papers have six authors, five have seven, and two have nine. One paper each lists 11, 14, 18, and 19 authors, and two papers have 15 authors.

Thirty-nine authors have more than one article in Figure 1. Two authors, L. Hood and S.F. Schlossman, have seven papers each. One has six—E.L. Reinherz. K. Calame and P. Early appear together on four papers. Seven authors—P. Chambon, M. Davis, G. Goldstein, P.C. Kung, T. Maniatis, J. Rogers, and R. Wall—each have three papers. Twenty-seven authors have two papers on the list.

Table 3 lists the 22 journals that published the most-cited articles in this study. Only three journals account for two-thirds of the papers. They are *Nature* (33 papers), *Cell* (19), and *Proceedings of the National Academy of Sciences of the USA—Biological Sciences* (18). The same three journals have dominated our studies of most-cited life sciences articles since 1978. This reflects a bias in citation-based studies that I've pointed out many times. Fields like molecular biology or biochemistry are more visible in these studies because there are so many papers published in these fields *and* these papers cite an

Table 1: The 1980 and 1981 research fronts which contain at least two of the 1980 most-cited life sciences papers as *core* documents. A = research front number. B = research front name. C = number of 1980 most-cited papers in the core of each research front.

A	B	C
80-0019	Transformation by and transcription of carcinogenic viruses	2
80-0043	Leukotrienes and slow-reacting substances of anaphylaxis	3
80-0359	Gene-related Hb diseases and thalassemia	3
80-0373	Gene sequences and structure in eukaryotes	2
80-0462	DNA gyrase, supercoiling, and DNA replication	2
80-0493	T-RNA gene transcription	3
80-0594	Molecular genetics of Ig complexes	6
80-0603	Molecular genetics, cloning methods and antitumor effects of interferon	3
80-1573	Monoclonal antibodies reactive with human cytotoxic T-cells in lymphocytic malignancies	2
80-2240	Binding properties of adenylate cyclase coupled β-adrenergic receptors	2
80-2334	Recognition of intervening sequences as an alternative to RNA splicing	2
81-0002	Small molecular weight nuclear RNA	5
81-0018	Sarcoma virus transforming proteins	4
81-0039	Organization, rearrangement and Ig gene expression	7
81-0108	E-coli recA protein activities	2
81-0136	Structural studies of fibroblast and leukocyte interferon genes	5
81-0155	IgM μ-chain expression in B-cell differentiation	2
81-0190	Proviral DNA of retrovirus, chromosome integration and RNA viral transformation	3
81-0211	Topoisomerases, gyrases and proteins controlling DNA structure	2
81-0287	Conformational studies of DNA and synthetic polynucleotides	2
81-0371	Leukotrienes and lipoxygenase pathways	6
81-0397	Transcription initiation and termination in eukaryotes	2
81-0684	DNA methylation and cellular differentiation	2
81-1181	Binding and activities of calmodulin	3
81-1554	Repeated sequences in DNA	2
81-1837	Genetic characterization of pseudogenes	2
81-2489	T-cell imbalance in disease	2
81-2600	Eukaryote gene transcription *in vitro*	2

Table 2: *ISI/BIOMED*® research fronts in which 1980 most-cited life sciences papers appear as *citing* papers.

*80-2179	RNA-polymerase and promotor interactions during transcription in E-coli
*80-2209	Evolution of biochemical pathways using methanobacterium
*81-0002	Small molecular weight nuclear RNA
*81-0125	Structure and function of fibronectin
*81-0141	Sodium butyrate and other inducers of cell differentiation
*81-0164	Prostaglandins and immune defense to cancer
*81-0246	Cholecystokinin receptors in brain
*81-0295	Mechanism of transposons
*81-0301	Benzodiazepine-binding and GABA receptors
*81-0345	Protein localization in E-coli membranes
*81-0425	Terminal deoxynucleotidyl transferase activity
*81-0428	Defects in the β-globin gene in β-thalassemia
*81-0594	Isolation, characterization, and cytologic roles of collagen
*81-0690	Regulatory components of adenylate cyclase and cholera toxin-dependent ADP ribosylation
*81-1705	Antigens specific for T-cell subpopulations

average of about 30 references per paper. Thus, the journals that publish a high proportion of papers in molecular biology or biochemistry will dominate.

The authors in this study were affiliated with 78 institutions in 14 countries. Table 4 lists these institutions in order of the number of times they appeared in Figure 1. The US accounts for 47 institutions, and nine are in the UK. Denmark, the Federal Republic of Germany, Sweden, and Switzerland each have three institutions. Two institutions each are located in Australia and France. Austria, Canada, Finland, Italy, Japan, and the Netherlands each have one.

I should point out that the two French institutions actually comprise several national institutes. The Institut National de la Santé et de la Recherche Medicale (INSERM) includes about 200 research units and groups. Authors on five papers in this study were affiliated with INSERM. All but one were produced at the Molecular Biology and Genetics Unit (Unit 184) of INSERM. In our study of the most-cited 1979 life sciences papers,[3] none of the authors were from INSERM.

The Centre National de la Recherche Scientifique (CNRS) includes more than ten national institutes, laboratories, and scientific departments. Four papers in this study listed authors from CNRS. All four of these papers, by the way, were coauthored with scientists from INSERM. In last year's study,[3] two papers listed authors from CNRS.

It is important to note that every one of the papers in Figure 1 was published in English, even though they come from 14 different nations. Table 5 shows the number of papers authored by scientists from these countries. For example, US authors were represented on 76 of the 105 papers in this study. Of these, 71 listed authors from the US *alone*—the remaining five papers were coauthored with scientists from Canada, France, the Federal Republic of Germany, Italy, Sweden, and the UK. Twelve papers listed UK authors, of which four were coau-

Table 3: The 22 journals represented on the list of 105 1980 life sciences papers most cited in 1980-1981. The numbers in parentheses are the impact factors for the journals. (1980 impact factor equals the number of citations received by 1978-1979 articles in a journal divided by the number of articles published by the journal during the same period.) Data were taken from the 1980 *Journal Citation Reports®*. The figures at the right indicate the number of papers from each journal which appears on the list.

Nature (6.5)	33
Cell (14.4)	19
*Proc. Nat. Acad. Sci. US—Biol. Sci. (Not Available)	18
Science (5.7)	7
Annu. Rev. Biochem. (24.9)	5
N. Engl. J. Med. (14.2)	5
J. Immunol. (6.4)	2
Prostaglandins (3.5)	2
Anal. Biochem. (2.2)	1
Brit. J. Haematol. (3.1)	1
Brit. J. Pharmacol. (4.5)	1
Clin. Immunol. Immunopathol. (2.7)	1
FEBS Lett. (3.0)	1
Int. J. Syst. Bact. (2.0)	1
J. Biol. Chem. (5.7)	1
J. Cell Biol. (9.7)	1
J. Exp. Med. (10.7)	1
Lancet (8.7)	1
Microbiol. Rev. (9.0)	1
Mol. Cell. Biochem. (1.6)	1
Mol. Pharmacol. (5.0)	1
Nucl. Acids Res. (5.1)	1

* In 1980, the journal *Proc. Nat. Acad. Sci. US* split into two sections. The 1980 impact factor for *Proc. Nat. Acad. Sci. US* is 8.8.

Table 4: The institutional affiliations of the authors on the list. Institutions are listed in descending order of the number of times they appeared in Figure 1.

Harvard Univ., Cambridge, MA		14
California Inst. Technology, Pasadena, CA		12
Univ. California		9
Los Angeles	3	
La Jolla	2	
San Francisco	2	
Davis	1	
Santa Cruz	1	
National Institutes of Health, Bethesda, MD		9
NCI	5	
NIAMDD	3	
NIMH	1	
CNRS, France		7
Inst. Chim. Biol., Strasbourg	3	
Lab. Genet. Mol., Paris	3	
Inst. Pasteur, Paris	1	
Sidney Farber Cancer Inst., Boston, MA		7
INSERM, Paris, France		5
Univ. London, UK		5
Imperial College	2	
King's College Hospital	1	
Royal Free Hospital	1	
St. Bartholomew's Hospital	1	
Duke Univ., Durham, NC		4
Karolinska Inst., Stockholm, Sweden		4
Salk Inst. Biol. Studies, San Diego, CA		4
Yale Univ., New Haven, CT		4
MRC Lab. Mol. Biol., Cambridge, UK		3
Ortho Pharmaceut. Corp., Raritan, NJ		3
Roche Inst. Mol. Biol., Nutley, NJ		3
Univ. Wisconsin, Madison, WI		3
Univ. Zurich, Switzerland		3
Basel Inst. Immunol., Switzerland		2
Brigham & Women's Hospital, Boston, MA		2
Carnegie Inst. Washington, Baltimore, MD		2
Cornell Univ., Ithaca, NY		2
Dalhousie Univ., Halifax, Canada		2
Howard Hughes Med. Inst.		2
Durham, NC	1	
San Francisco, CA	1	
Imperial Cancer Research Fund, London, UK		2
Massachusetts Inst. Technology, Cambridge, MA		2
Royal College Surgery, London, UK		2
Royal Marsden Hospital, Sutton, UK		2
Stanford Univ. and Med. Ctr., CA		2
Univ. Washington, Seattle, WA		2
Washington Univ., St Louis, MO		2
A.R.C. Plant Breeding Institute, Cambridge, UK		1
A S Ferrosan, Soeborg, Denmark		1
Baylor Coll. Med., Houston, TX		1
Beth Israel Hospital, Boston, MA		1
Central Public Health Lab., Helsinki, Finland		1
Children's Hospital Med. Ctr., Boston, MA		1
City of Hope Nat. Med. Ctr., Duarte, CA		1
Cold Spring Harbor Lab., NY		1
Dr. Margarete Fischer-Bosch Inst. Klin. Pharmacol., Stuttgart, FRG		1
E.I. du Pont de Nemours & Co., Wilmington, DE		1
Fox Chase Cancer Ctr., Philadelphia, PA		1
Genentech Inc., San Francisco, CA		1
Hutchinson Cancer Ctr., Seattle, WA		1
Inst. Cancer Research, Sutton, UK		1
Japanese Fdn. Cancer Research, Tokyo, Japan		1
Johns Hopkins Univ., Baltimore, MD		1
Munich Technical Univ., FRG		1
National Jewish Hospital, Denver, CO		1
New York Univ., NY		1
Purdue Univ., West Lafayette, IN		1
Rockefeller Univ., New York, NY		1
Roswell Park Memorial Inst., Buffalo, NY		1
Royal Vet. Agr. Univ., Copenhagen, Denmark		1
Scripps Clin. Res. Fdn., La Jolla, CA		1
St. Hans Hospital, Roskilde, Denmark		1
Tufts Univ., Boston, MA		1
Univ. Alabama, Birmingham, AL		1
Univ. Amsterdam, Netherlands		1
Univ. Arizona, Tucson, AZ		1
Univ. Chicago, IL		1
Univ. Cologne, FRG		1
Univ. Colorado, Denver, CO		1
Univ. Geneva, Switzerland		1
Univ. Genoa, Italy		1
Univ. Graz, Austria		1
Univ. Houston, TX		1
Univ. Illinois, Urbana, IL		1
Univ. Leicester, UK		1
Univ. New Hampshire, Durham, NH		1
Univ. New Mexico, Albuquerque, NM		1
Univ. Queensland, St. Lucia, Australia		1
Univ. Rochester, NY		1
Univ. Sussex, Brighton, UK		1
Univ. Umeå, Sweden		1
Univ. Uppsala, Sweden		1
Univ. Virginia, Charlottesville, VA		1
Walter and Eliza Hall Inst. Med. Research, Victoria, Australia		1
Washington State Univ., Pullman, WA		1

thored with Australian, Canadian, West German, and US scientists.

As I said earlier, the papers in Figure 1 are assigned to 14 broad subject areas:

molecular genetics, immunology, immunogenetics, virology/viral oncology, cell biology/physiology, leukotrienes, neurobiology, interferon, pharmacology, calmodulin, endocrinology, bacteriology, biochemistry, and oncology. Molecular genetics papers are subcategorized into gene expression and regulation, nucleic acid structure, globin gene expression, and "selfish" genes, to give a total of 17 subject areas.

Fourteen papers in molecular genetics are concerned with gene expression and regulation. Most of them discuss genetic transcription and splicing. The third most-cited paper in this study, by M.R. Lerner and colleagues, Yale University, explains the role of "small nuclear ribonucleoproteins" (snRNPs) in splicing RNA. This paper was cited 56 times in 1980 and 151 times in 1981. It is a core document in a 1981 research front named "Small molecular weight nuclear RNA," and in a 1980 research front named "Recognition of intervening sequences as an alternative to RNA splicing."

Eleven molecular genetics papers focus on nucleic acid structure. The second most-cited paper is in this group. "Linkage map of *Escherichia coli* K-12, edition 6," by B.J. Bachmann and K.B. Low, Yale University, is a 56-page article published in *Microbiological Reviews*. Cited 225 times in the 1980-1981 period, it has also been cited 192 times in 1982, reflecting the great amount of activity in this field.

Five papers in molecular genetics discuss the evolution, structure, and characterization of human globin genes. All five were published in *Cell*. Two others concern "selfish" genes, DNA sequences that appear to have little or no function beyond their own survival in the cell. These two papers appeared side by side in *Nature*.

Ten papers in this study are in immunology. Seven of them list S.F. Schlossman, Harvard University School of Medicine, as an author. And six of these list E.L. Reinherz, also of Harvard, as a coauthor. As in earlier studies, almost all of the immunology papers concentrate on T-cells, which constitute the cell-mediated portion of the immune system.

Table 5: National affiliations of the authors of the 1980 life sciences papers most cited in 1980-1981, in order of the total number of papers on which each nation's authors appeared (column A). B=number of papers coauthored with scientists from other countries. C=nationality of coauthors.

Country	A	B	C
US	76	5	Canada, France, FRG, Italy, Sweden & UK
UK	12	4	Australia, Canada, FRG & US
Sweden	6	3	France, Switzerland & US
Switzerland	6	3	Finland, Japan & Sweden
France	5	2	Sweden & US
FRG	3	1	Canada, UK & US
Australia	2	1	UK
Canada	2	1	FRG, UK & US
Austria	1	0	
Denmark	1	0	
Finland	1	1	Switzerland
Italy	1	1	US
Japan	1	1	Switzerland
Netherlands	1	0	

Nine papers are classified under immunogenetics. All of them discuss immunoglobin, the protein that acts as an antibody. More than half of the immunogenetics papers list L. Hood, California Institute of Technology, as an author. Seven papers in this group are core documents in research front #81-0039, "Organization, rearrangement and Ig gene expression." The other two papers are in research front #81-0155, "IgM μ-chain expression in B-cell differentiation."

Virology accounts for nine most-cited 1980 papers. Almost all relate to viruses involved in cancer—five papers are on tumor viruses and two are on leukemia viruses. They are included as core documents in two research fronts: #81-0018, "Sarcoma virus transforming proteins" and #81-0190, "Proviral DNA of retrovirus, chromosome integration and RNA viral transformation."

There are six papers in cell biology/physiology. The fourth most-cited paper is included here. That paper, by E. Lazarides, California Institute of Technology, discusses the cellular function of intermediate filaments. It received 181 citations in 1980-1981.

Six papers identify and characterize various kinds of leukotrienes. Also known as "slow-reacting substances of anaphylaxis" (SRS-A), leukotrienes are involved in asthma and other allergic reactions. All six papers are core documents in research front #81-0371, "Leukotrienes and lipoxygenase pathways."

Six papers are in neurobiology. Only one of them deals with enkephalin, an endogenous opiate. In our 1977 study of most-cited life sciences papers,[1] 11 dealt with endogenous opiates; in 1978,[2] there was one; and last year,[3] there were four papers on this topic.

Five papers discuss the structure and synthesis of interferon. All are core papers in research front #81-0136, "Structural studies of fibroblast and leukocyte interferon genes."

Pharmacology accounts for five papers. Three of these discuss drug therapies for various ailments—anxiety, coronary artery spasm, and gastrointestinal bleeding. One paper discusses the effectiveness of a powerful new immunosuppressant for preventing graft-versus-host disease after bone marrow transplantation. The last pharmacology paper details the interaction between two widely used drugs, diazepam and cimetidine.

Four papers are on calmodulin, a protein involved in the regulation of calcium metabolism. The most-cited paper in this study, by W.Y. Cheung, University of Washington, Seattle, details calmodulin's role in cellular regulation. It received 88 citations in 1980, 257 in 1981, and 208 in 1982.

There are four papers in endocrinology. The one by M. Rodbell, National Institutes of Health, received 162 citations. It presents an explanation of the role hormone receptors play in regulating adenylate cyclase. Adenylate cyclase is an enzyme system located in the cell membrane that binds with hormones and neurotransmitters.

Bacteriology, biochemistry, and oncology each contributed three papers. One of the bacteriology papers lists 19 authors. It gives the developmental history of prokaryotes, organisms without a defined nucleus that reproduce by cell division. The 19 authors of this paper are affiliated with ten institutions in four countries.

I'm sure most of the papers identified in this study will be highly cited for several years to come. Citation frequency within a few years of publication is a reliable indicator of a paper's lifetime citation expectancy. Incidentally, if you would like to find out what current papers are assigned to any *ISI/BIOMED* cluster, you need only dial up the ISI Search Network and key in the appropriate research front number.

The next essay in this series will examine the 1980 physical sciences papers most cited in 1980 and 1981.

* * * * *

My thanks to Dorothy Silver and Alfred Welljams-Dorof for their help in the preparation of this essay.

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