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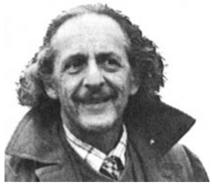

The 1980 Chemistry Articles Most Cited in 1980-1982

Number 35

In recent essays, we presented the 1980 life and physical sciences papers that received the most citations in 1980 and 1981.[1,2] In this essay, we'll examine the most-cited 1980 chemistry papers. This is the first time we've devoted a separate study to highly cited chemistry papers. In other studies, chemistry papers were usually combined with papers from the other physical sciences. However, chemistry papers seemed to be underrepresented in these "combined" studies, in which highly cited physics papers dominated.

This has been solved in two ways. First, enough time has elapsed since the original studies of 1980 papers so that we are able to include another year of citation data. Had we not done this, many of the papers in this study may not have reached the required threshold. There seems to be a "lag time" between publication and citation of superstar chemistry papers. While this lag time may prove to be a more general phenomenon in chemistry, it is not conclusively proved by this study. But there are several indications that physical chemistry, for example, may have a longer lag time than other disciplines in chemistry.

Second, in order to identify the most-cited chemistry papers, we examined a printout that ranks all 1980 papers cited in *Science Citation Index*® (*SCI*®) by the number of citations they received from 1980 to 1982. Then we selected those papers published in chemistry journals. This was supplemented by a search for all chemistry papers published in multidisciplinary journals, such as *Science* or *Nature*.

Of course, it is often difficult to make decisions about papers published in fields like chemical physics, which we included in our last study.[2] Judith Ellen Sarkisian, senior staff chemist in ISI®'s Chemical Information Division, made the categorizations which, in some cases, may seem arbitrary due to the overlapping of fields. The departmental affiliation is often as good a clue as we can use to make such distinctions. This accounts for the inclusion of papers published in chemical physics journals in this study as well as in the earlier study of physical sciences papers.[2]

Table 1 lists the 108 chemistry papers selected. The number of citations they received during 1980-1982 is also shown. We only include about 100 papers in these studies primarily because of time and space limitations. Only 97 papers had been cited over 30 times. So we decided to include 11 more articles, each of which was cited 30 times. Thus, the list includes 108 articles.

The average paper in Table 1 received 43 citations during the three-year period—four in 1980, 17 in 1981, and 22 in 1982. Most of the four million papers and books cited in *SCI* each year receive only one or two citations. And the average article published in one of the journals we cover in *SCI* will be cited three to five times in three years. So the papers in this study are unique in terms of citation frequency and *immediacy*. We do not claim that these papers represent the "best" or most original chemical research. And the inclusion of citation counts is not meant to suggest that one paper is "better" than another. The im-

Table 1: The 1980 chemistry articles most cited in 1980-1982. The authors' addresses follow the bibliographic data. Code numbers indicate the 1982 and 1983 *ISR*™ research front specialties for which these are core papers. A = number of citations received, 1980. B = number of citations received, 1981. C = number of citations received, 1982. D = number of citations received, 1980-1982.

A	B	C	D	Bibliographic Data
				Physical/Inorganic Chemistry
2	19	13	34	Bergmann K, Hefter U & Witt J. **State-to-state differential cross sections for rotationally inelastic scattering of Na_2 by He.** *J. Chem. Phys.* 72:4777-90, 1980. Univ. Kaiserslautern, Dept. Phys., Kaiserslautern, FRG.
8	38	80	126	Binkley J S, Pople J A & Hehre W J. **Self-consistent molecular orbital methods. 21. Small split-valence basis sets for first-row elements.** *J. Amer. Chem. Soc.* 102:939-47, 1980. Carnegie-Mellon Univ., Dept. Chem., Pittsburgh, PA; Univ. Calif., Dept. Chem., Irvine, CA. 82-0397, 83-0802
7	18	17	42	Bolton P H & James T L. **Fast and slow conformational fluctuations of RNA and DNA. Subnanosecond internal motion correlation times determined by ^{31}P NMR.** *J. Amer. Chem. Soc.* 102:25-31, 1980. Univ. Calif., Sch. Pharm., San Francisco, CA. 82-0482, 83-0782
4	10	16	30	Cox R A & Sheppard D. **Reactions of OH radicals with gaseous sulphur compounds.** *Nature* 284:330-1, 1980. AERE, Environ. Med. Sci. Div., Oxford; Univ. Birmingham, Dept. Chem., Birmingham, UK.
4	14	26	44	Creutz C, Chou M, Netzel T L, Okumura M & Sutin N. **Lifetimes, spectra, and quenching of the excited states of polypyridine complexes of iron(II), ruthenium(II), and osmium(II).** *J. Amer. Chem. Soc.* 102:1309-19, 1980. Brookhaven Natl. Lab., Chem. Dept., Upton, NY.
1	15	17	33	Felix F, Ferguson J, Gudel H U & Ludi A. **The electronic spectrum of $Ru(bpy)_3^{2+}$.** *J. Amer. Chem. Soc.* 102:4096-102, 1980. Australian Natl. Univ., Res. Sch. Chem., Canberra, Australia; Univ. Bern, Inst. Inorgan. Chem., Bern, Switzerland. 83-1808
3	30	27	60	Fendler J H. **Surfactant vesicles as membrane mimetic agents: characterization and utilization.** *Account. Chem. Res.* 13:7-13, 1980. Texas A&M Univ., Dept. Chem., College Station, TX. 82-1567, 83-0754
7	13	12	32	Gassman P G & Talley J J. Letter to editor. (**The α-cyano group as a substituent in solvolysis reactions. An evaluation of inductive destabilization vs. mesomeric stabilization of cations by the cyano moiety.**) *J. Amer. Chem. Soc.* 102:1214-6, 1980. Univ. Minnesota, Dept. Chem., Minneapolis, MN.
3	6	26	35	Goodman D W, Kelley R D, Madey T E & Yates J T. **Kinetics of the hydrogenation of CO over a single crystal nickel catalyst.** *J. Catal.* 63:226-34, 1980. Natl. Bur. Standards, Surface Sci. Div., Washington, DC. 83-0591
7	13	12	32	Heller E J. **Quantum intramolecular dynamics: criteria for stochastic and nonstochastic flow.** *J. Chem. Phys.* 72:1337-47, 1980. Univ. Calif., Dept. Chem., Los Angeles, CA.
2	13	24	39	Hirth J P. **Effects of hydrogen on the properties of iron and steel.** *Met. Trans. A—Phys. Met. Mater. Sc.* 11:861-90, 1980. Ohio State Univ., Dept. Met. Eng., Columbus, OH.
4	11	15	30	Holmes J L & Lossing F P. **Gas-phase heats of formation of keto and enol ions of carbonyl compounds.** *J. Amer. Chem. Soc.* 102:1591-5, 1980. Univ. Ottawa, Dept. Chem.; Natl. Res. Council, Div. Chem., Ottawa, Canada.
8	14	13	35	Hopkins J B, Powers D E, Mukamel S & Smalley R E. **Vibrational relaxation in jet-cooled alkylbenzenes. II. Fluorescence spectra.** *J. Chem. Phys.* 72:5049-61, 1980. Rice Univ., Rice Quantum Inst. & Dept. Chem., Houston, TX.
6	13	19	38	Hopkins J B, Powers D E & Smalley R E. **Vibrational relaxation in jet-cooled alkylbenzenes. I. Absorption spectra.** *J. Chem. Phys.* 72:5039-48, 1980. Rice Univ., Rice Quantum Inst. & Dept. Chem., Houston, TX.
1	12	27	40	Jencks W P. **When is an intermediate not an intermediate? Enforced mechanisms of general acid-base catalyzed, carbocation, carbanion, and ligand exchange reactions.** *Account. Chem. Res.* 13:161-9, 1980. Brandeis Univ., Grad. Dept. Biochem., Waltham, MA. 83-0613
9	23	22	54	Johnson P M. **Molecular multiphoton ionization spectroscopy.** *Account. Chem. Res.* 13:20-6, 1980. SUNY, Dept. Chem., Stony Brook, NY. 82-0917, 83-1113
2	9	19	30	Konowalow D D, Rosenkrantz M E & Olson M L. **The molecular electronic structure of the lowest $^1\Sigma_g^+$, $^3\Sigma_u^+$, $^1\Sigma_u^+$, $^3\Sigma_g^+$, $^1\Pi_u$, $^1\Pi_g$, $^3\Pi_u$, and $^3\Pi_g$ states of Na_2.** *J. Chem. Phys.* 72:2612-5, 1980. SUNY, Dept. Chem., Binghamton, NY. 83-2691
2	13	15	30	Krishnan R, Binkley J S, Seeger R & Pople J A. **Self-consistent molecular orbital methods. XX. A basis set for correlated wave functions.** *J. Chem. Phys.* 72:650-4, 1980. Carnegie-Mellon Univ., Dept. Chem., Pittsburgh, PA.
2	14	14	30	Lamb J D, Christensen J J, Izatt S R, Bedke K, Astin M S & Izatt R M. **Effects of salt concentration and anion on the rate of carrier-facilitated transport of metal cations through bulk liquid membranes containing crown ethers.** *J. Amer. Chem. Soc.* 102:3399-403, 1980. Brigham Young Univ., Dept. Chem. Eng., Dept. Chem. & Thermochem. Inst., Provo, UT.
1	17	18	36	Lemieux R U, Bock K, Delbaere L T J, Koto S & Rao V S. **The conformations of oligosaccharides related to the ABH and Lewis human blood group determinants.** *Can. J. Chem.* 58:631-53, 1980. Univ. Alberta, Dept. Chem., Edmonton, Canada.
4	16	25	45	Lindman B & Wennerstrom H. **Micelles. Amphiphile aggregation in aqueous solution.** *Top. Curr. Chem.* 87:1-83, 1980. Univ. Lund, Chem. Ctr., Lund, Sweden. 83-2797
8	17	23	48	Miller W H, Handy N C & Adams J E. **Reaction path Hamiltonian for polyatomic molecules.** *J. Chem. Phys.* 72:99-112, 1980. Univ. Calif., Lawrence Berkeley Lab. & Dept. Chem., Berkeley, CA. 83-2150

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1 12 25 38 Pinhas A R, Albright T A, Hofmann P & Hoffmann R. **A class of trinuclear clusters with carbonyl bridging.** *Helv. Chim. Acta* 63:29-49, 1980. Cornell Univ., Dept. Chem., Ithaca, NY; Univ. Houston, Houston, TX; Univ. Erlangen, Inst. Organ. Chem., Erlangen, FRG. 83-1103

3 18 13 34 Pollak E, Child M S & Pechukas P. **Classical transition state theory: a lower bound to the reaction probability.** *J. Chem. Phys.* 72:1669-78, 1980. Hebrew Univ., Inst. Advan. Stud., Jerusalem, Israel; Columbia Univ., Dept. Chem., New York, NY. 82-1284

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1 24 27 52 Roos B O, Taylor P R & Siegbahn P E M. **A complete active space SCF method (CASSCF) using a density matrix formulated super-CI approach.** *Chem. Phys.* 48:157-73, 1980. Univ. Lund, Chem. Ctr., Lund; Univ. Stockholm, Inst. Theor. Phys., Stockholm, Sweden. 82-1013, 83-1761

5 9 22 36 Siegbahn P E M. **Generalizations of the direct CI method based on the graphical unitary group approach. II. Single and double replacements from any set of reference configurations.** *J. Chem. Phys.* 72:1647-56, 1980. Univ. Stockholm, Inst. Theor. Phys., Stockholm, Sweden. 83-1268

5 16 14 35 Skolnick J & Helfand E. **Kinetics of conformational transitions in chain molecules.** *J. Chem. Phys.* 72:5489-500, 1980. Bell Labs., Murray Hill, NJ.

5 9 16 30 Solomon E I, Hare J W, Dooley D M, Dawson J H, Stephens P J & Gray H B. **Spectroscopic studies of stellacyanin, plastocyanin, and azurin. Electronic structure of the blue copper sites.** *J. Amer. Chem. Soc.* 102:168-78, 1980. Calif. Inst. Technol., Arthur Amos Noyes Lab. Chem. Phys., Pasadena, CA. 83-0291

7 15 11 33 Sparks R K, Carlson L R, Shobatake K, Kowalczyk M L & Lee Y T. **Ozone photolysis: a determination of the electronic and vibrational state distributions of primary products.** *J. Chem. Phys.* 72:1401-2, 1980. Univ. Calif., Lawrence Berkeley Lab. & Dept. Chem., Berkeley, CA.

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2 16 12 30 Van Hemelrijk D, Van den Enden L, Geise H J, Sellers H L & Schafer L. **Structure determination of 1-butene by gas electron diffraction, microwave spectroscopy, molecular mechanics, and molecular orbital constrained electron diffraction.** *J. Amer. Chem. Soc.* 102:2189-95, 1980. Univ. Antwerp, Dept. Chem., Wilrijk, Belgium; Univ. Arkansas, Dept. Chem., Fayetteville, AR.

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Photochemistry/Electrochemistry

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8 22 30 60 Bard A J, Bocarsly A B, Fan F-R F, Walton E G & Wrighton M S. **The concept of Fermi level pinning at semiconductor/liquid junctions. Consequences for energy conversion efficiency and selection of useful solution redox couples in solar devices.** *J. Amer. Chem. Soc.* 102:3671-7, 1980. Univ. Texas, Dept. Chem., Austin, TX; Mass. Inst. Technol., Dept. Chem., Cambridge, MA. 82-0695, 83-0773

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4 11 16 31 Bocarsly A B, Walton E G & Wrighton M S. **Use of chemically derivatized n-type silicon photoelectrodes in aqueous media. Photo-oxidation of iodide, hexacyanoiron(II), and hexaammineruthenium(II) at ferrocene-derivatized photoanodes.** *J. Amer. Chem. Soc.* 102:3390-8, 1980. Mass. Inst. Technol., Dept. Chem., Cambridge, MA. 83-1104

4 20 21 45 Brugger P-A & Gratzel M. Letter to editor. **(Light-induced charge separation by functional micellar assemblies.)** *J. Amer. Chem. Soc.* 102:2461-3, 1980. Ecole Polytech. Fed. Lausanne, Inst. Chem. Phys., Lausanne, Switzerland. 82-0470, 83-0754

1 15 18 34 Chance R R, Shacklette L W, Miller G G, Ivory D M, Sowa J M, Elsenbaumer R L & Baughman R H. **Highly conducting charge-transfer complexes of a processible polymer: poly(p-phenylene sulphide).** *J. Chem. Soc. Chem. Commun.* (8):348-9, 1980. Allied Chem. Corp., Corporate Res. Ctr., Morristown, NJ. 83-1104

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A	B	C	D	
1	14	32	47	Daum P, Lenhard J R, Rolison D & Murray R W. **Diffusional charge transport through ultrathin films of radiofrequency plasma polymerized vinylferrocene at low temperature.** *J. Amer. Chem. Soc.* 102:4649-53, 1980. Univ. North Carolina, Kenan Labs. Chem., Chapel Hill, NC. 83-0169
7	11	15	33	Fan F-R F & Bard A J. **Semiconductor electrodes. 24. Behavior and photoelectrochemical cells based on p-type GaAs in aqueous solutions.** *J. Amer. Chem. Soc.* 102:3677-83, 1980. Univ. Texas, Dept. Chem., Austin, TX.
3	15	13	31	Fan F-R F, White H S, Wheeler B & Bard A J. **Semiconductor electrodes. XXIX. High efficiency photoelectrochemical solar cells with n-WSe_2 electrodes in an aqueous iodide medium.** *J. Electrochem. Soc.* 127:518-20, 1980. Univ. Texas, Dept. Chem., Austin, TX.
6	17	9	32	Goodman N B, Fritzsche H & Ozaki H. **Determination of the density of states of a-Si:H using the field effect.** *J. Non-Cryst. Solids* 35:599-604, 1980. Univ. Chicago, James Franck Inst., Chicago, IL.
6	17	21	44	Infelta P P, Gratzel M & Fendler J H. **Aspects of artificial photosynthesis. Photosensitized electron transfer and charge separation in cationic surfactant vesicles.** *J. Amer. Chem. Soc.* 102:1479-83, 1980. Ecole Polytech. Fed. Lausanne, Inst. Chem. Phys., Lausanne, Switzerland. 83-0754
4	24	23	51	Kalyanasundaram K & Gratzel M. **Light induced redox reactions of water soluble porphyrins, sensitization of hydrogen generation from water by zincporphyrin derivatives.** *Helv. Chim. Acta* 63:478-85, 1980. Ecole Polytech. Fed. Lausanne, Inst. Chem. Phys., Lausanne, Switzerland. 82-0470, 83-0754
9	19	30	58	Kaufman F B, Schroeder A H, Engler E M, Kramer S R & Chambers J Q. **Ion and electron transport in stable, electroactive tetrathiafulvalene polymer coated electrodes.** *J. Amer. Chem. Soc.* 102:483-8, 1980. IBM T.J. Watson Res. Ctr., Yorktown Heights, NY. 82-0932, 83-0169
3	8	22	33	Kautek W & Gerischer H. **Photoelectrochemical reactions and formation of inversion layers at n-type MoS_2-, $MoSe_2$-, and WSe_2-electrodes in aprotic solvents.** *Ber. Bunsen Ges. Phys. Chem.* 84:645-53, 1980. Max Planck Soc. Advan. Sci., Fritz Haber Inst., Berlin, FRG. 83-2238
2	14	29	45	Kawai T & Sakata T. **Photocatalytic decomposition of gaseous water over TiO_2 and TiO_2—RuO_2 surfaces.** *Chem. Phys. Lett.* 72:87-9, 1980. Inst. Mol. Sci., Okazaki, Japan. 83-0755
4	16	30	50	Keller P, Moradpour A, Amouyal E & Kagan H B. **Hydrogen production by visible-light using viologen-dye mediated redox cycles.** *Nouv. J. Chim.* 4:377-84, 1980. Univ. Paris-Sud, Lab. Phys. Solids & Lab. Proc. Photophys. Photochem. & Lab. Synth. Asymmetr., Orsay, France. 83-0754
2	24	21	47	Kiwi J, Borgarello E, Pelizzetti E, Visca M & Gratzel M. **Cyclic water cleavage by visible light: drastic improvement of yield of H_2 and O_2 with bifunctional redox catalysts.** *Angew. Chem. Int. Ed.* 19:646-8, 1980. Ecole Polytech. Fed. Lausanne, Inst. Chem. Phys., Lausanne, Switzerland; Univ. Torino, Inst. Chem. Analyt., Torino; SIBIT SpA, Ctr. Res., Spinetta Marengo, Italy. 82-0470, 83-0754
3	14	18	35	Krasna A I. **Acridines, deazaflavins, and tris(2,2'-bipyridine)ruthenium as catalysts for photoproduction of hydrogen from organic compounds.** *Photochem. Photobiol.* 31:75-82, 1980. Columbia Univ., Coll. Phys. & Surg., New York, NY. 83-0754
2	14	20	36	Lehn J M, Sauvage J P & Ziessel R. **Zeolite supported metal oxide catalysts for the photoinduced oxygen generation from water.** *Nouv. J. Chim.* 4:355-8, 1980. Univ. Louis Pasteur, Inst. Le Bel, Strasbourg, France. 83-0754
5	22	21	48	Lewerenz H J, Heller A & DiSalvo F J. **Relationship between surface morphology and solar conversion efficiency of WSe_2 photoanodes.** *J. Amer. Chem. Soc.* 102:1877-80, 1980. Bell Labs., Murray Hill, NJ. 82-0695, 83-2238
2	31	44	77	Murray R W. **Chemically modified electrodes.** *Account. Chem. Res.* 13:135-41, 1980. Univ. North Carolina, Kenan Labs. Chem., Chapel Hill, NC. 82-0932, 83-0169
5	12	23	40	Nowak R J, Schultz F A, Umana M, Lam R & Murray R W. **Chemically modified electrodes. Radiofrequency plasma polymerization of vinylferrocene on glassy carbon and platinum electrodes.** *Anal. Chem.* 52:315-21, 1980. Univ. North Carolina, Kenan Labs. Chem., Chapel Hill, NC. 83-0169
2	20	34	56	Oyama N & Anson F C. **Catalysis of electrode processes by multiply-charged metal complexes electrostatically bound to polyelectrolyte coatings on graphite electrodes, and the use of polymer-coated rotating disk electrodes in diagnosing kinetic and conduction mechanisms.** *Anal. Chem.* 52:1192-8, 1980. Calif. Inst. Technol., Arthur Amos Noyes Lab., Pasadena, CA. 82-0932, 83-0169
8	13	25	46	Oyama N & Anson F C. **Electrostatic binding of metal complexes to electrode surfaces coated with highly charged polymeric films.** *J. Electrochem. Soc.* 127:247-8, 1980. Calif. Inst. Technol., Arthur Amos Noyes Lab., Pasadena, CA. 83-0169
6	19	20	45	Oyama N & Anson F C. **Factors affecting the electrochemical responses of metal complexes at pyrolytic graphite electrodes coated with films of poly(4-vinylpyridine).** *J. Electrochem. Soc.* 127:640-7, 1980. Calif. Inst. Technol., Arthur Amos Noyes Lab., Pasadena, CA. 82-0932, 83-0169
4	11	37	52	Park Y-W, Heeger A J, Druy M A & MacDiarmid A G. **Electrical transport in doped polyacetylene.** *J. Chem. Phys.* 73:946-57, 1980. Univ. Pennsylvania, Dept. Phys., Dept. Chem. & Lab. Res. Struct. Matter, Philadelphia, PA. 83-0832
1	13	22	36	Rabolt J F, Clarke T C, Kanazawa K K, Reynolds J R & Street G B. **Organic metals: poly-(p-phenylene sulphide) hexafluoroarsenate.** *J. Chem. Soc. Chem. Commun.* (8):347-8, 1980. IBM Res. Lab., San Jose, CA. 83-1104
1	12	22	35	Sato S & White J M. **Photodecomposition of water over Pt/TiO_2 catalysts.** *Chem. Phys. Lett.* 72:83-6, 1980. Univ. Texas, Dept. Chem., Austin, TX. 83-0755
4	26	36	66	Whitten D G. **Photoinduced electron-transfer reactions of metal complexes in solution.** *Account. Chem. Res.* 13:83-90, 1980. Univ. North Carolina, Dept. Chem., Chapel Hill, NC. 82-0470, 83-0754

Organic/Organometallic Chemistry

A	B	C	D	
3	8	20	31	Bally T & Masamune S. **Cyclobutadiene.** *Tetrahedron* 36:343-70, 1980. Mass. Inst. Technol., Dept. Chem., Cambridge, MA.
13	33	47	93	Bartlett P A. **Stereocontrol in the synthesis of acyclic systems: applications to natural product synthesis.** *Tetrahedron* 36:3-72, 1980. Univ. Calif., Dept. Chem., Berkeley, CA.
1	20	19	40	Bradshaw J S & Stott P E. **Preparation of derivatives and analogs of the macrocyclic oligomers of ethylene oxide (crown compounds).** *Tetrahedron* 36:461-510, 1980. Brigham Young Univ., Dept. Chem. & Thermochem. Inst., Provo, UT.
5	22	31	58	Brieger G & Bennett J N. **The intramolecular Diels-Alder reaction.** *Chem. Rev.* 80:63-97, 1980. Oakland Univ., Dept. Chem., Rochester, MI. 82-0996, 83-1237
4	13	23	40	Casey C P, Andrews M A, McAlister D R & Rinz J E. **Reduction of coordinated carbon monoxide. Synthesis of neutral metal formyl and hydroxymethyl derivatives of the $(C_5H_5)Re(CO)_2(NO)^+$ cation.** *J. Amer. Chem. Soc.* 102:1927-33, 1980. Univ. Wisconsin, Dept. Chem., Madison, WI. 83-1189
6	17	24	47	Chan A S C & Halpern J. Letter to editor. **(Interception and characterization of a hydridoalkyl-rhodium intermediate in a homogeneous catalytic hydrogenation reaction.)** *J. Amer. Chem. Soc.* 102:838-40, 1980. Univ. Chicago, Dept. Chem., Chicago, IL. 83-1290
7	14	17	38	Collum D B, McDonald J H & Still W C. Letter to editor. **(Synthesis of the polyether antibiotic monensin. 2. Preparation of intermediates.)** *J. Amer. Chem. Soc.* 102:2118-20, 1980. Columbia Univ., Dept. Chem., New York, NY.
7	9	15	31	Corey E J, Albright J O, Barton A E & Hashimoto S. Letter to editor. **(Chemical and enzymic syntheses of 5-HPETE, a key biological precursor of slow-reacting substance of anaphylaxis (SRS), and 5-HETE.)** *J. Amer. Chem. Soc.* 102:1435-6, 1980. Harvard Univ., Dept. Chem., Cambridge, MA.
22	41	38	101	Corey E J, Clark D A, Goto G, Marfat A & Mioskowski C. Letter to editor. **(Stereospecific total synthesis of a "slow reacting substance" of anaphylaxis, leukotriene C-1.)** *J. Amer. Chem. Soc.* 102:1436-9, 1980. Harvard Univ., Dept. Chem., Cambridge, MA; Karolinska Inst., Dept. Chem., Stockholm, Sweden. 82-0331, 83-0666
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3	16	36	55	Engel P S. **Mechanism of the thermal and photochemical decomposition of azoalkanes.** *Chem. Rev.* 80:99-150, 1980. Rice Univ., Dept. Chem., Houston, TX.
1	14	15	30	Funk R L & Vollhardt K P C. **Thermal, photochemical, and transition-metal mediated routes to steroids by intramolecular Diels-Alder reactions of *o*-xylylenes (*o*-quinodimethanes).** *Chem. Soc. Rev.* 9:41-61, 1980. Univ. Calif., Dept. Chem. & Lawrence Berkeley Lab., Berkeley, CA. 83-1237
4	21	25	50	Gladfelter W L & Geoffroy G L. **Mixed-metal clusters.** *Advan. Organometal. Chem.* 18:207-73, 1980. Univ. Minnesota, Dept. Chem., Minneapolis, MN; Penn State Univ., Dept. Chem., University Park, PA.
21	27	20	68	Hammarstrom S, Samuelsson B, Clark D A, Goto G, Marfat A, Mioskowski C & Corey E J. **Stereochemistry of leukotriene C-1.** *Biochem. Biophys. Res. Commun.* 92:946-53, 1980. Karolinska Inst., Dept. Chem., Stockholm, Sweden; Harvard Univ., Dept. Chem., Cambridge, MA. 82-0331, 83-0666
7	32	28	67	Heathcock C H, Buse C T, Kleschick W A, Pirrung M C, Sohn J E & Lampe J. **Acyclic stereoselection. 7. Stereoselective synthesis of 2-alkyl-3-hydroxy carbonyl compounds by aldol condensation.** *J. Org. Chem.* 45:1066-81, 1980. Univ. Calif., Dept. Chem., Berkeley, CA. 82-1529
1	14	21	36	Huffman J C, Lewis L N & Caulton K G. **A donor semibridge? Molecular structures of dicyclopentadienyldivanadium tetracarbonyl triphenylphosphine and dicyclopentadienyldivanadium pentacarbonyl.** *Inorg. Chem.* 19:2755-62, 1980. Indiana Univ., Dept. Chem. & Molec. Struct. Ctr., Bloomington, IN.
2	18	28	48	Ibers J A & Holm R H. **Modeling coordination sites in metallobiomolecules.** *Science* 209:223-35, 1980. Northwestern Univ., Dept. Chem., Evanston, IL; Harvard Univ., Dept. Chem., Cambridge, MA.
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5	22	14	41	Martin S F. **Methodology for the construction of quaternary carbon centers.** *Tetrahedron* 36:419-60, 1980. Univ. Texas, Dept. Chem., Austin, TX.
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mediate impact of these papers is a strong indicator that many of them will prove to be "important" by future peer judgment, if that is not already apparent.

Keep in mind that many 1980 chemistry papers not included in Table 1 will eventually become highly cited. Had we included 1983 citations, we could easily add more papers cited at least 30 times. But the citation rankings of the papers would change. We've identified some of the "hot spots" in chemical research, but many important discoveries require a longer incubation period. Such "delayed recognition"[3] is a fascinating subject about which much is said but little researched. Those who are sometimes troubled by the seeming inequities in funding research in chemistry might well use such data to establish appropriate guidelines for measuring the impact of fields like physical and organic chemistry.

In this connection, it is important to observe that if we had included papers cited at least 27 times, two papers from the *Journal of Physical Chemistry* would have appeared in Table 1. "Absolute rate constant of the reaction $OH + H_2O_2 \rightarrow HO_2 + H_2O$ from 245 to 423-K," by L.F. Keyser, California Institute of Technology, Pasadena, was cited 29 times from 1980 to 1982.[4] And "Thermodynamic analysis of the growth of sodium dodecyl sulfate micelles," by P.J. Missel and colleagues, Massachusetts Institute of Technology, Cambridge, and Harvard Medical School, Boston, received 27 citations from 1980 to 1982.[5]

For convenience, the 108 papers in this study are divided into four broad subject categories—physical/inorganic chemistry, photochemistry/electrochemistry, organic/organometallic chemistry, and analytical chemistry. The papers are listed within each category in alphabetic order by first author. This arrangement is intended to discourage invidious comparisons by citation frequency.

More than half of the papers are included as *core* publications in the research fronts we now include in *Index to Scientific Reviews*™ (*ISR*™). They are indicated by the research front numbers

Table 2: The 1982 and 1983 *ISR*™ research fronts which contain at least two of the 1980 most-cited chemistry papers as core documents. A = research front number. B = research front name. C = number of 1980 most-cited chemistry papers included in the core of each research front.

A	B	C
82-0331	Leukotriene studies	4
82-0470	Water cleavage into hydrogen and oxygen by visible light	4
82-0673	Ion mass spectrometry of organic compounds	2
82-0695	Layer-structured transition metal dichalcogenides	2
82-0932	Studies of electrodes coated with polymer complexes	4
83-0169	Use of polymer-coated electrodes	7
83-0591	Hydrocarbon synthesis over Fisher-Tropsch catalysts; hydrogenation of carbon monoxide over ruthenium, nickel and other metal catalysts	2
83-0666	Studies of leukotrienes and their role as mediators of allergic reactions	2
83-0754	Photosensitizers, electron transfer agents and other factors of photochemical water cleavage in artificial photosynthetic systems	9
83-0755	Photoinduced water cleavage with colloidal suspensions of semiconductor particles as catalysts	2
83-0773	Semiconductor electrodes in photoelectrochemical solar cells	2
83-0832	Electronic properties of polyacetylene	2
83-1104	Electronic properties of polypyrrole and other conducting polymers; use of conducting polymers in semiconductor photo-electrodes for solar energy conversion	3
83-1237	Stereochemical aspects of intramolecular Diels-Alder cyclo-addition reactions	2
83-1761	Multiconfigurational and complete active space SCF calculations of molecular properties	2
83-2238	Photoelectrochemical studies of molybdenum disulfide, molybdenum diselenide, tungsten diselenide and other compounds	2
83-2533	Study of collision-induced dissociation by triple quadrupole mass spectrometry and other mass spectrometry techniques	2

that follow the bibliographic information in Table 1. I've explained elsewhere how we process *SCI* to identify these fronts or specialties.[6] A research front consists of a group of current papers that cite one or more papers identified as core for that topic. While the majority of the papers are *already* identified as core papers, you may reasonably ask why others are not. This is a function of the thresholds of co-citation which were established for identifying the research fronts. By modifying our future clustering thresholds, more of these primordial papers will cluster with other papers that are highly cited. But it may often turn out that a single paper will be sufficient to identify a new and emerging field. This has been the source of the retrieval power of the citation index. Each paper is an incipient clustering tag or symbol.

The names of the research fronts that include at least two papers from this study in their cores are shown in Table 2. Column A lists the research front numbers. Research front names are derived from the phrases and words most frequently used in the current articles that cited the core papers. Column C shows the number of papers from this study included in the core of each front.

Twenty-one of the papers in Table 1 are single author works. Twenty-nine papers list two authors, 20 have three, 14 have four authors, 17 have five, three have six, three have seven, and one paper has eight authors.

Twenty-five authors have more than one paper. Three authors have four papers each—A.J. Bard, E.J. Corey, and M. Grätzel. Nine authors each have three papers—F.C. Anson, A.B. Bocarsly, D.A. Clark, F.-R.F. Fan, G. Goto, A. Marfat, R.W. Murray, N. Oyama, and M.S. Wrighton. Thirteen authors have two papers on the list.

Table 3 lists the 35 journals that published the most-cited chemistry articles in this study. Only three journals account for more than half of the 108 papers: *Journal of the American Chemical Society* (35 papers), *Journal of Chemical Physics* (14), and *Accounts of Chemical Research* (7). We've indicated before that the *Journal of the American Chemical Society* is the most-cited journal in the world, in part because of its long history, but primarily due to its high quality. Last year it was cited over 100,000 times.[7] And it continues to maintain high impact.

Table 3: The 35 journals represented on the list of the 108 1980 chemistry papers most cited in 1980-1982. The numbers in parentheses are the impact factors. (1980 impact factor equals the number of 1980 citations to 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 appear on the list.

J. Amer. Chem. Soc. (5.2)	35
J. Chem. Phys. (3.2)	14
Account. Chem. Res. (8.8)	7
Tetrahedron (1.6)	6
Anal. Chem. (3.3)	4
J. Electrochem. Soc. (1.9)	3
Anal. Chim. Acta (2.0)	2
Biochem. Biophys. Res. Commun. (3.0)	2
Chem. Phys. Lett. (2.1)	2
Chem. Rev. (10.2)	2
Helv. Chim. Acta (1.8)	2
J. Chem. Soc. Chem. Commun. (2.4)	2
J. Chromatogr. Sci. (2.5)	2
J. Org. Chem. (2.0)	2
Nouv. J. Chim. (2.0)	2
Science (5.7)	2
Advan. Chem. Phys. (3.4)	1
Advan. Organometal. Chem. (9.5)	1
Amer. Mineral. (1.1)	1
Angew. Chem. Int. Ed. (4.8)	1
Appl. Spectrosc. (1.7)	1
Ber. Bunsen Ges. Phys. Chem. (1.4)	1
Can. J. Chem. (1.2)	1
Chem. Phys. (2.4)	1
Chem. Soc. Rev. (4.2)	1
Coord. Chem. Rev. (2.7)	1
Inorg. Chem. (2.6)	1
J. Catal. (2.7)	1
J. Chromatogr. (2.1)	1
J. Non-Cryst. Solids (2.7)	1
Met. Trans. A—Phys. Met. Mater. Sc. (0.8)	1
Nature (6.5)	1
Photochem. Photobiol. (2.5)	1
Tetrahedron Lett. (2.0)	1
Top. Curr. Chem. (3.7)	1

Accounts of Chemical Research, however, is a review journal. In fact, there are eight review journals in this study, and they published 18 of the most-cited chemistry articles. In our study of the most-cited 1980 life sciences papers,[1] two review journals contributed six papers. In comparison, there were two articles from two review journals in our study of the most-cited physical sciences papers.[2]

Certain journals are conspicuous by their absence in Table 3, especially those in physical chemistry. For this and other reasons, we will do a separate study of this field in the near future.

Incidentally, the only two articles in Table 1 from France appeared in the *Nouveau Journal de Chimie* which, in spite of its French title, publishes mainly in the English language. This should be of no small interest to those Francophiles who would insist that French chemists publish exclusively in French.

The authors represented in this study were affiliated with 78 institutions in 15 countries. These institutions are listed in Table 4 in descending order by the number of times they appeared in Table 1. The US alone accounts for 42 of these 78 institutions, and five are in Canada. The Federal Republic of Germany (FRG), Switzerland, Sweden, and the UK each account for four institutions. Three are located in Japan. Australia, Belgium, France, and Italy account for two each. Denmark, Israel, the German Democratic Republic (GDR), and the Estonian Soviet Socialist Republic each have one. The last two, in fact, appear on a paper published jointly by the Institute of Cybernetics in Tallinn and the Chemical Institutes of the GDR Academy of Sciences in Berlin. It is a significant comment on the international character of the *Journal of the American Chemical Society* that this study was published in that journal.

Table 4: The institutional affiliations of the authors on the list. Institutions are listed in descending order of the number of papers produced.

Univ. California, CA		11
Berkeley	6	
Irvine	2	
Los Angeles	2	
San Francisco	1	
Univ. Texas, Austin, TX		7
Massachusetts Inst. Technol., Cambridge, MA		5
California Inst. Technol., Pasadena, CA		5
Harvard Univ., Cambridge, MA		5
Ecole Polytech. Fed. Lausanne, Switzerland		4
Univ. North Carolina, Chapel Hill, NC		4
Bell Labs., Murray Hill, NJ		3
Columbia Univ., New York, NY		3
Karolinska Inst., Stockholm, Sweden		3
Rice Univ., Houston, TX		3
SUNY		3
Binghamton	1	
Buffalo	1	
Stony Brook	1	
Brigham Young Univ., Provo, UT		2
Carnegie-Mellon Univ., Pittsburgh, PA		2
Cornell Univ., Ithaca, NY		2
IBM		2
Res. Lab., San Jose, CA	1	
Thomas J. Watson Res. Ctr. Yorktown Heights, NY	1	
Princeton Univ., NJ		2
Univ. Chicago, IL		2
Univ. Kaiserslautern, FRG		2
Univ. Lund, Sweden		2
Univ. Minnesota, Minneapolis, MN		2
Univ. Pennsylvania, Philadelphia, PA		2
Univ. Stockholm, Sweden		2
Acad. Sci. GDR, Berlin, GDR		1
Allied Chem. Corp., Morristown, NJ		1
Atomic Energy Res. Est., Oxford, UK		1
Australian Natl. Univ., Canberra, Australia		1
Brandeis Univ., Waltham, MA		1
Brookhaven Natl. Lab., Upton, NY		1
Carnegie Inst. Washington, DC		1
Ciba-Geigy AG, Basel, Switzerland		1
E.I. du Pont de Nemours & Co., Wilmington, DE		1
Estonian S.S.R. Acad. Sci., Tallinn, USSR		1
Finnigan Corp., Sunnyvale, CA		1
Hebrew Univ., Jerusalem, Israel		1
Indiana Univ., Bloomington, IN		1
Inst. Mol. Sci., Okazaki, Japan		1
Kyoto Univ., Japan		1
La Trobe Univ., Bundoora, Australia		1
Louisiana State Univ., Baton Rouge, LA		1
Max Planck Soc. Advan. Sci. (Fritz Haber Inst.) Berlin, FRG		1
Merck Frosst Res. Labs., Pointe Claire, Canada		1
Monsanto Co., St. Louis, MO		1
Nagoya Univ., Japan		1
Natl. Bureau Standards, Washington, DC		1
Natl. Res. Council, Ottawa, Canada		1
Nicolet Instrum. Corp., Madison, WI		1
Northwestern Univ., Evanston, IL		1
Oakland Univ., Rochester, MI		1
Ohio State Univ., Columbus, OH		1
Oxford Univ., UK		1
Pennsylvania State Univ., University Park, PA		1
Purdue Univ., West Lafayette, IN		1
Seton Hall Univ., South Orange, NJ		1
SIBIT SpA, Spinetta Marengo, Italy		1
Swiss Fed. Inst. Technol., Zurich, Switzerland		1
Tech. Univ. Denmark, Lyngby, Denmark		1
Texas A&M Univ., College Station, TX		1
Univ. Alberta, Edmonton, Canada		1
Univ. Antwerp, Wilrijk, Belgium		1
Univ. Arkansas, Fayetteville, AR		1
Univ. Bern, Switzerland		1
Univ. Birmingham, UK		1
Univ. British Columbia, Vancouver, Canada		1
Univ. East Anglia, Norwich, UK		1
Univ. Erlangen, FRG		1
Univ. Frankfurt, FRG		1
Univ. Ghent, Belgium		1
Univ. Houston, TX		1
Univ. Louis Pasteur, Strasbourg, France		1
Univ. Ottawa, Canada		1
Univ. Paris XI—Paris-Sud, Orsay, France		1
Univ. Pittsburgh, PA		1
Univ. Torino, Italy		1
Univ. Uppsala, Sweden		1
Univ. Virginia, Charlottesville, VA		1
Univ. Wisconsin, Madison, WI		1
Waters Assocs. Inc., Milford, MA		1

Although the most-cited chemistry papers were written in 15 countries, every one was published in English. Table 5 shows these countries, and the number of papers published. US authors, for example, appeared on 80 papers in Table 1, of which seven were coauthored with researchers from Australia, Belgium, FRG, Israel, and Sweden. That is, 73 of the 108 papers in this study listed *only* US authors.

As explained earlier, the papers in this study were assigned to four broad subject areas. Thirty-five papers are included under physical/inorganic chemistry. Most of these papers describe the physical properties of a number of elements, molecules, and compounds as determined by various methods of analysis. Others discuss the structure of both simple and complex compounds. The most-cited paper in this study appears in this category. "Self-consistent molecular orbital methods. 21. Small split-valence basis sets for first-row elements" by J.S. Binkley and J.A. Pople, Carnegie-Mellon University, Pittsburgh, Pennsylvania, and W.J. Hehre, University of California, Irvine, was published in *Journal of the American Chemical Society.* It has received 126 citations—eight in 1980, 38 in 1981, and 80 in 1982.

Twenty-nine papers are in photochemistry or electrochemistry. Much of the research in this field concentrates on the conversion of solar energy to electrical and chemical energy. Specific areas of research include the transport of electron charges through semiconductors, splitting water molecules to produce hydrogen and oxygen gases, and various chemical reactions induced by electrodes in liquids.

Organic and organometallic chemistry accounts for 27 papers. These papers discuss the synthesis and properties of many natural and organic, or "carbon-based," compounds. The second most-cited paper is in this group. It discusses leukotriene C-1, a substance involved in asthma and other allergic reactions. E.J. Corey and colleagues, Harvard University, Cambridge, Massachusetts, described the synthesis of leukotriene C-1 in *Journal of the American Chemical Society.* It was cited 101 times—22 in 1980, 41 in 1981, and 38 in 1982.

This paper, and three others in this section, are core documents in *ISR* research front number 82-0331, "Leukotriene studies." Leukotrienes are also the subject of intense research activity in the life sciences. In our study of the most-cited 1980 life sciences papers, six were concerned with leukotrienes.[1] There are numerous biomedical research fronts for this field in the *Index to Research Fronts in ISI/BIOMED® 1982.*[8] Incidentally, the 1983 edition has now been published.

The remaining 17 papers in this study are in analytical chemistry. Almost all of these discuss the separation, identification, and structural analysis of complex molecules and compounds.

This concludes our series of studies of the most-cited 1980 articles in the life, physical, and chemical sciences. Most of the papers identified in these studies will continue to be highly cited in the future. A paper's lifetime citation rate can be forecasted reasonably well by its citation frequency in the first few years following publication. But forecasts are always subject to qualification.

ISI is planning to produce several new online data bases in chemistry. These

Table 5: National affiliations of the authors of the 1980 chemistry articles most cited in 1980-1982, 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	80	7	Australia, Belgium, FRG, Israel, Sweden
Sweden	7	3	US
Switzerland	6	2	Australia, Italy
Canada	4	0	
FRG	3	1	US
Japan	3	0	
UK	3	0	
Australia	2	2	Switzerland, US
Belgium	2	1	US
France	2	0	
Denmark	1	0	
GDR	1	1	USSR
Israel	1	1	US
Italy	1	1	Switzerland
USSR	1	1	GDR

will cover the main branches of chemistry and will be modeled on our series of disciplinary data bases covering the literature of biomedicine, geology, and math. That is, you will be able to search these data bases to retrieve information of all types, including the core papers for each of the thousands of specialties we identify.

In addition, you will soon be able to search online all the information covered in ISI's *Current Abstracts of Chemistry and Index Chemicus®* (*CAC&IC®*). This online service is searchable by analytical techniques, biological activities, molecular formulas, chemical structures, subject terms, and conventional bibliographic terms. The data base features full graphic input and output of chemical structures. More about *CAC&IC* online will be reported in the future.

Journal editors often inquire if we can identify the most-cited papers for their journals, or if it is possible to organize what amounts to an individual journal citation index. This is not only possible but quite relevant because we have just completed an article-by-article citation analysis for a group of journals that gives a six-year citation history for articles they published in 1977. In these studies, we are able to separate the many different types of "items" a journal publishes—research articles, reviews, notes, letters, editorials, etc.—and compute separate impact factors for each. If you are interested in obtaining data for one or more journals, please contact Susan Jones, manager of journal services at ISI.

* * * * *

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