Essays of an Information Scientist, Vol:8, p.327-338, 1985
Current Contents, #35, p.3-14, September 2, 1985

Current Comments®

EUGENE GARFIELD
INSTITUTE FOR SCIENTIFIC INFORMATION®
3501 MARKET ST., PHILADELPHIA, PA 19104

The 1981 Most-Cited Chemistry Papers. Part 2. Highlighting the Arbitrary Boundaries between Chemistry and Physics

Number 35 September 2, 1985

A few months ago, we reported on a list of interesting "chemistry" papers published in 1981 that had been derived primarily from the *Index Chemicus®* (*IC®*).[1] This list was composed mostly of pure and synthetic chemistry articles published in the 112 journals indexed by *IC* in 1981. We recognized, however, that imperfections occur in any categorization based on journal titles, so we decided to augment this list with one based on journals covered by our new *Chemistry Citation Index*™ (*CCI*™), a subset of the *Science Citation Index®* (*SCI®*) that reports data from 1978 to 1983. The focus of the *CCI* is on all areas of chemistry, exclusive of biochemistry and molecular biology. Naturally, then, the *CCI* file stresses physical, inorganic, organic, spectroscopic, and analytical chemistry. I'll have more to say about the *CCI* later, once this database is more widely available. In the meantime, we used it to identify the types of chemistry papers that were omitted from the earlier analyses of 1981 literature[1,2]—those from physical chemistry, chemical physics, chemical engineering, and the like. Looking at these papers also reminded us of the complexities of defining the physical chemistry-chemical physics interface. A separate study of journals in that area will be reported shortly.

Strictly speaking, the bibliography of 100 papers in Table 1 does not include the most-cited papers in the *CCI*. These already showed up in the list of papers reported in Part 1 of this study. For example, any papers from the *Journal of the American Chemical Society* (*JACS*) that were previously listed are excluded here, even though they may now rank higher. I don't think it is important to explain these subtle differences in this essay. In general, these "classification" exercises are designed to place greater emphasis on fields and subjects that might be drowned out by the "weight" of publication in biochemistry or *JACS*.

This phenomenon is best illustrated by the list of *SCI* and combined *SCI* and *Social Sciences Citation Index®* (*SSCI®*) research fronts that we have provided in Table 2. Three of these 13 fronts (#82-1104, #82-1040, and #83-2813) concern polymers, while two (#83-1380, #83-3408) discuss nuclear magnetic resonance (NMR) spectroscopy. Two of these fronts—#82-1104 and #83-1380—along with #83-1064, appeared in Part 1 of the study. The 541 papers concerning multinuclear two-dimensional NMR spectroscopy (#83-1380) provide a good example of publication activity in 1983 alone. According to Wallace Brey, Department of Chemistry, University of Florida, Gainesville, activity in phosphorous, nitrogen, silicon, and metal NMR is growing rapidly.[3]

Keep in mind that Table 2 includes only those *SCI* or *SCI/SSCI* research fronts that contain as core documents two or more papers from Table 1. Many additional fronts contain one paper from the list, but they are too numerous to list in a separate table. All the research-

Table 1: The 1981 chemistry articles most cited in the *SCI*®, 1981-1983 (Part 2), listed in alphabetic order by first author. The authors' affiliations follow each citation. Code numbers indicate the 1982 *SCI* and the 1983 *SCI/SSCI*® research-front specialties for which these are core papers. Code numbers with an asterisk (*) indicate the 1982-1983 *CCI*™ research-front specialties for which these are core papers. A = number of 1981 citations. B = number of 1982 citations. C = number of 1983 citations. D = total for 1981-1983. The number of 1984 citations follows in parentheses. E = bibliographic information.

A	B	C	D	E
8	14	10	32 (5)	**Amirav A, Even U & Jortner J.** Excited-state dynamics of the isolated ultracold ovalene molecule. *J. Chem. Phys.* 74:3745-56, 1981. Tel-Aviv Univ., Dept. Chem., Israel.
0	17	25	42 (35)	**Appel R, Knoll F & Ruppert I.** Phospha-alkenes and phospha-alkynes, genesis and properties of the (p-p)π-multiple bond. *Angew. Chem. Int. Ed.* 20:731-44, 1981. Rheinische Friedrich-Wilhelms Univ., Inorg. Chem. Inst., Bonn, FRG. 83-1039
6	13	23	42 (21)	**Backx C, de Groot C P M & Biloen P.** Adsorption of oxygen on Ag(110) studied by high resolution ELS and TPD. *Surface Sci.* 104:300-17, 1981. Shell Res. BV, Koninklijke(Royal Dutch)/Shell Lab., Amsterdam, the Netherlands. 83-0190
2	16	23	41 (23)	**Bailey D C & Langer S H.** Immobilized transition-metal carbonyls and related catalysts. *Chem. Rev.* 81:109-48, 1981. Univ. Wisconsin, Dept. Chem. Eng., Madison, WI. *83-0340
10	17	35	62 (11)	**Balle T J & Flygare W H.** Fabry-Perot cavity pulsed Fourier transform microwave spectrometer with a pulsed nozzle particle source. *Rev. Sci. Instr.* 52:33-45, 1981. Univ. Illinois, Noyes Chem. Lab., Urbana, IL. 83-1695
0	17	28	45 (38)	**Bartlett R J.** Many-body perturbation theory and coupled cluster theory for electron correlation in molecules. *Annu. Rev. Phys. Chem.* 32:359-401, 1981. Battelle Mem. Inst., Columbus, OH. 82-0802
0	14	39	53 (59)	**Bax A & Freeman R.** Investigation of complex networks of spin-spin coupling by two-dimensional NMR. *J. Magn. Resonance* 44:542-61, 1981. Univ. Oxford, Phys. Chem. Lab., UK. 83-1380
4	22	22	48 (38)	**Bax A, Freeman R, Frenkiel T A & Levitt M H.** Assignment of carbon-13 NMR spectra via double-quantum coherence. *J. Magn. Resonance* 43:478-83, 1981. Univ. Oxford, Phys. Chem. Lab., UK. 82-0665, 83-1380
1	15	29	45 (32)	**Bax A & Morris G A.** An improved method for heteronuclear chemical shift correlation by two-dimensional NMR. *J. Magn. Resonance* 42:501-5, 1981. Univ. Oxford, Phys. Chem. Lab., UK. 83-1380
2	14	18	34 (22)	**Bell A T.** Catalytic synthesis of hydrocarbons over group VIII metals. A discussion of the reaction mechanism. *Catal. Rev.—Sci. Eng.* 23:203-32, 1981. Univ. California, Lawrence Berkeley Lab. & Dept. Chem. Eng., Berkeley, CA. 83-1064
0	9	23	32 (10)	**Bendall M R, Pegg D T & Doddrell D M.** Polarization transfer pulse sequences for two-dimensional NMR by Heisenberg vector analysis. *J. Magn. Resonance* 45:8-29, 1981. Griffith Univ., Sch. Sci., Nathan, Australia. 83-1380
4	8	20	32 (14)	**Benjamin M M & Leckie J O.** Multiple-site adsorption of Cd, Cu, Zn, and Pb on amorphous iron oxyhydroxide. *J. Colloid Interface Sci.* 79:209-21, 1981. Univ. Washington, Seattle, WA; Stanford Univ., CA. 83-1353
8	14	13	35 (10)	**Bertolini J C & Tardy B.** Vibrational EELS studies of CO chemisorption on clean and carbided (111), (100) and (110) nickel surfaces. *Surface Sci.* 102:131-50, 1981. CNRS, Catalyst Res. Inst., Villeurbanne, France. 82-0419
6	15	18	39 (21)	**Bij K E, Horvath C, Melander W R & Nahum A.** Surface silanols in silica-bonded hydrocarbonaceous stationary phases. II. Irregular retention behavior and effect of silanol masking. *J. Chromatogr.* 203:65-84, 1981. Yale Univ., Dept. Eng. Appl. Sci., New Haven, CT. 83-0809
0	13	22	35 (19)	**Bisi O & Calandra C.** Transition metal silicides: aspects of the chemical bond and trends in the electronic structure. *J. Phys.—C—Solid State Phys.* 14:5479-94, 1981. Univ. Modena, Phys. Inst.; CNR, Natl. Res. Grp. Struct. Mat.(GNSM), Rome, Italy. *83-0006
0	15	24	39 (27)	**Brown D W, Nakashima T T & Rabenstein D L.** Simplification and assignment of carbon-13 NMR spectra with spin-echo Fourier transform techniques. *J. Magn. Resonance* 45:302-14, 1981. Univ. Alberta, Dept. Chem., Edmonton, Canada. 83-1380
0	16	21	37 (3)	**Bursill L A, Lodge E A & Thomas J M.** New light on the crystal structure of zeolite A. *J. Phys. Chem.* 85:2409-21, 1981. Univ. Cambridge, Dept. Phys. Chem., UK. 83-3408

A	B	C	D	E
2	17	18	37 (12)	**Campbell C T, Ertl G, Kuipers H & Segner J.** A molecular beam investigation of the interactions of CO with a Pt(111) surface. *Surface Sci.* 107:207-19, 1981. Univ. Munich, Inst. Phys. Chem., FRG. *83-0716
10	6	20	36 (2)	**Campbell E J, Buxton L W, Balle T J & Flygare W H.** The theory of pulsed Fourier transform microwave spectroscopy carried out in a Fabry-Perot cavity: static gas. *J. Chem. Phys.* 74:813-28, 1981. Univ. Illinois, Noyes Chem. Lab., Urbana, IL. *83-0208
15	5	18	38 (7)	**Campbell E J, Buxton L W, Balle T J, Keenan M R & Flygare W H.** The gas dynamics of a pulsed supersonic nozzle molecular source as observed with a Fabry-Perot cavity microwave spectrometer. *J. Chem. Phys.* 74:829-40, 1981. Univ. Illinois, Noyes Chem. Lab., Urbana, IL. *83-0208
8	13	23	44 (5)	**Cardillo M J.** Nature of the Si(111)7x7 reconstruction. *Phys. Rev. B—Condensed Matter* 23:4279-82, 1981. Bell Labs., Murray Hill, NJ. 83-2788
0	17	19	36 (7)	**Carlson N W, Taylor A J, Jones K M & Schawlow A L.** Two-step polarization-labeling spectroscopy of excited states of Na_2. *Phys. Rev. A—Gen. Phys.* 24:822-34, 1981. Stanford Univ., Dept. Phys., CA. 83-4038
2	21	17	40 (19)	**Cavenett B C.** Optically detected magnetic resonance (O.D.M.R.) investigations of recombination processes in semiconductors. *Advan. Phys.* 30:475-538, 1981. Univ. Hull, Dept. Phys., UK. 83-4163
4	14	17	35 (8)	**Chaiken J, Gurnick M & McDonald J D.** Average singlet-triplet coupling properties of biacetyl and methylglyoxal using quantum beat spectroscopy. *J. Chem. Phys.* 74:106-16, 1981. Univ. Illinois, Sch. Chem. Sci., Urbana, IL. *83-0564
6	18	22	46 (22)	**Chen C K, de Castro A R B & Shen Y R.** Surface-enhanced second-harmonic generation. *Phys. Rev. Lett.* 46:145-8, 1981. Univ. California, Dept. Phys. & Lawrence Berkeley Lab., Berkeley, CA. 82-1025, 83-2981
0	17	22	39 (21)	**Chow F, Kempe T & Palm G.** Synthesis of oligodeoxyribonucleotides on silica gel support. *Nucl. Acid. Res.* 9:2807-17, 1981. KabiGen AB, Dept. Chem., Stockholm, Sweden. 83-0684
9	25	62	96 (59)	**Clegg W.** Faster data collection without loss of precision. An extension of the learnt profile method. *Acta Crystallogr. A* 37:22-8, 1981. Univ. Gottingen, Inst. Inorg. Chem., FRG. 83-4507
4	20	19	43 (12)	**Curtiss C F & Bird R B.** A kinetic theory for polymer melts. I. The equation for the single-link orientational distribution function. *J. Chem. Phys.* 74:2016-25, 1981. Univ. Wisconsin, Dept. Chem., Theor. Chem. Inst., Chem. Eng. Dept. & Rheol. Res. Ctr., Madison, WI. 82-1040, 83-2813
3	17	16	36 (9)	**Curtiss C F & Bird R B.** A kinetic theory for polymer melts. II. The stress tensor and the rheological equation of state. *J. Chem. Phys.* 74:2026-33, 1981. Univ. Wisconsin, Dept. Chem., Theor. Chem. Inst., Chem. Eng. Dept. & Rheol. Res. Ctr., Madison, WI. 82-1040, 83-2813
8	22	18	48 (28)	**Daum P & Murray R W.** Charge-transfer diffusion rates and activity relationships during oxidation and reduction of plasma-polymerized vinylferrocene films. *J. Phys. Chem.* 85:389-96, 1981. Univ. N. Carolina, Kenan Labs. Chem., Chapel Hill, NC. 82-0169, 83-3898
1	14	18	33 (15)	**Dehnicke K & Strahle J.** The transition metal-nitrogen multiple bond. *Angew. Chem. Int. Ed.* 20:413-26, 1981. Tubingen Univ., Inst. Inorg. Chem.; Marburg Univ., Dept. Chem., FRG. 83-5191
2	19	14	35 (17)	**Delos J B.** Theory of electronic transitions in slow atomic collisions. *Rev. Mod. Phys.* 53:287-357, 1981. Coll. William and Mary, Phys. Dept., Williamsburg, VA.
1	18	19	38 (29)	**Drew H R & Dickerson R E.** Structure of a *B*-DNA dodecamer. III. Geometry of hydration. *J. Mol. Biol.* 151:535-56, 1981. Caltech, Norman W. Church Lab. Chem. Biol., Pasadena, CA. 82-0691
1	18	20	39 (11)	**Eberhardt W, Greuter F & Plummer E W.** Bonding of H to Ni, Pd, and Pt surfaces. *Phys. Rev. Lett.* 46:1085-8, 1981. Univ. Pennsylvania, Lab. Res. Struct. Matter & Dept. Phys., Philadelphia, PA. 83-2279
2	20	13	35 (8)	**Fairman R D, Chen R T, Oliver J R & Ch'en D R.** Growth of high-purity semi-insulating bulk GaAs for integrated-circuit applications. *IEEE Trans. Electron Devices* ED-28:135-40, 1981. Rockwell Intl., Electron. Res. Ctr., Thousand Oaks, CA. 82-2008, 83-0019
0	17	15	32 (16)	**Fan F-R F, Wheeler B L, Bard A J & Noufi R N.** Semiconductor electrodes. XXXIX. Techniques for stabilization of n-silicon electrodes in aqueous solution photoelectrochemical cells. *J. Electrochem. Soc.* 128:2042-5, 1981. Univ. Texas, Dept. Chem., Austin, TX; Solar Energy Res. Inst., Photo Voltaic Div., Golden, CO. 82-1104

A	B	C	D	E
4	15	16	35 (19)	**Fleischmann M, Hendra P J, Hill I R & Pemble M E.** Enhanced Raman spectra from species formed by the coadsorption of halide ions and water molecules on silver electrodes. *J. Electroanal. Chem. Interfac.* 117:243-55, 1981. Univ. Southampton, Dept. Chem., UK. *83-1561
2	10	20	32 (12)	**Fleming I.** Some uses of silicon compounds in organic synthesis. *Chem. Soc. Rev.* 10:83-111, 1981. Univ. Cambridge, Univ. Chem. Lab., UK. 83-4661
3	18	14	35 (19)	**Ford P C.** The water gas shift reaction: homogeneous catalysis by ruthenium and other metal carbonyls. *Account. Chem. Res.* 14:31-7, 1981. Univ. California, Dept. Chem., Santa Barbara, CA. 82-2098
7	23	24	54 (13)	**Frenkel F, Hager J, Krieger W, Walther H, Campbell C T, Ertl G, Kuipers H & Segner J.** Rotationally inelastic gas-surface scattering investigated by laser-induced fluorescence. *Phys. Rev. Lett.* 46:152-5, 1981. Max Planck Soc. Adv. Sci., Laser Res. Project Grp., Garching; Univ. Munich, Inst. Phys. Chem., FRG. 82-2123, 83-4161
11	14	10	35 (10)	**Fromherz P.** Micelle structure: a surfactant-block model. *Chem. Phys. Lett.* 77:460-6, 1981. Max Planck Inst. Biophys. Chem., Dept. Dev. Mol. Syst., Gottingen-Nikolausberg, FRG. 83-5354
1	25	39	65 (44)	**Garrou P E.** Δ_R ring contributions to ^{31}P NMR parameters of transition-metal–phosphorus chelate complexes. *Chem. Rev.* 81:229-66, 1981. Dow Chem., Cent. Res.-New Engl. Lab., Wayland, MA. 83-6430
3	18	18	39 (21)	**Goldberg S M, Fadley C S & Kono S.** Photoionization cross-sections for atomic orbitals with random and fixed spatial orientation. *J. Electron Spectrosc. Relat. Ph.* 21:285-363, 1981. Univ. Hawaii, Dept. Chem., Honolulu, HI.
0	18	47	65 (59)	**Gratzel M.** Artificial photosynthesis: water cleavage into hydrogen and oxygen by visible light. *Account. Chem. Res.* 14:376-84, 1981. Ecole Polytech. Fed., Inst. Chem. Phys., Lausanne, Switzerland. 83-6785
1	21	11	33 (20)	**Grob K, Grob G & Grob K.** Capillary columns with immobilized stationary phases. I. A new simple preparation procedure. *J. Chromatogr.* 211:243-6, 1981. ETH, Gas Chromatogr. Lab., Dubendorf; Kantonales Lab., Zurich, Switzerland. 82-2319
2	25	12	39 (20)	**Grob K & Grob G.** Capillary columns with immobilized stationary phases. II. Practical advantages and details of procedure. *J. Chromatogr.* 213:211-21, 1981. ETH, Gas Chromatogr. Lab., Dubendorf, Switzerland. 82-2319, 83-1379
1	20	13	34 (24)	**Gros L, Ringsdorf H & Schupp H.** Polymeric antitumor agents on a molecular and on a cellular level? *Angew. Chem. Int. Ed.* 20:305-25, 1981. Johannes Gutenberg Univ. Mainz, Inst. Org. Chem., FRG. 82-2193
5	13	15	33 (16)	**Hagerman P J.** Investigation of the flexibility of DNA using transient electric birefringence. *Biopolymers* 20:1503-35, 1981. Univ. Colorado Med. Ctr., Denver, CO. *83-1173
8	22	18	48 (20)	**Harriman A, Porter G & Richoux M-C.** Photosensitised reduction of water to hydrogen using water-soluble zinc porphyrins. *J. Chem. Soc. Faraday Trans. II* 77:833-44, 1981. Royal Inst. Great Britain, Davy Faraday Res. Lab., London, UK. 82-0754
0	17	17	34 (28)	**Harvey R G.** Activated metabolites of carcinogenic hydrocarbons. *Account. Chem. Res.* 14:218-26, 1981. Univ. Chicago, Ben May Lab., IL. 83-0144
1	24	17	42 (45)	**Heller A.** Conversion of sunlight into electrical power and photoassisted electrolysis of water in photoelectrochemical cells. *Account. Chem. Res.* 14:154-62, 1981. Bell Labs., Murray Hill, NJ. 82-0774, 83-0489
1	16	17	34 (17)	**Heller A & Vadimsky R G.** Efficient solar to chemical conversion: 12% efficient photoassisted electrolysis in the [*p*-type InP(Ru)]/HCl-KCl/Pt(Rh) cell. *Phys. Rev. Lett.* 46:1153-6, 1981. Bell Labs., Murray Hill, NJ. *83-0050
11	17	14	42 (12)	**Holczer K, Boucher J P, Devreux F & Nechtschein M.** Magnetic-resonance studies in undoped *trans*-polyacetylene, $(CH)_x$. *Phys. Rev. B—Condensed Matter* 23:1051-63, 1981. Ctr. Etudes Nucl. Grenoble, Dept. Fundamen. Res., France. 82-0832
4	16	16	36 (14)	**Impey R W, Klein M L & McDonald I R.** Molecular dynamics studies of the structure of water at high temperatures and density. *J. Chem. Phys.* 74:647-52, 1981. Univ. Cambridge, Univ. Chem. Lab. & Dept. Phys. Chem., UK; Natl. Res. Ctr. Canada, Chem. Div., Ottawa, Canada. 82-2552
0	8	24	32 (15)	**Johnson B F G & Lewis J.** Transition-metal molecular clusters. *Advan. Inorg. Chem. Radiochem.* 24:225-355, 1981. Univ. Cambridge, Univ. Chem. Lab., UK. 83-4350

A	B	C	D	E
2	21	28	51 (47)	**Jones B N, Paabo S & Stein S.** Amino acid analysis and enzymatic sequence determination of peptides by an improved o-phthaldialdehyde precolumn labeling procedure. *J. Liq. Chromatogr.* 4:565-86, 1981. Hoffmann-La Roche Inc., Roche Inst. Mol. Biol., Nutley, NJ. 82-2459, 83-2127
3	14	15	32 (16)	**Kaye J A & Kuppermann A.** Collinear quantum mechanical probabilities for the I+HI→IH+I reaction using hyperspherical coordinates. *Chem. Phys. Lett.* 77:573-9, 1981. Caltech., Arthur Amos Noyes Lab. Chem. Phys., Pasadena, CA. *83-0567
1	23	25	49 (20)	**Kleyn A W, Luntz A C & Auerbach D J.** Rotational energy transfer in direct inelastic surface scattering: NO on Ag(111). *Phys. Rev. Lett.* 47:1169-75, 1981. IBM, Res. Lab., San Jose, CA. 82-2123, 83-4161
1	13	19	33 (16)	**Klingshirn C & Haug H.** Optical properties of highly excited direct gap semiconductors. *Phys. Rep.—Rev. Sect. Phys. Lett.* 70:315-98, 1981. Univ. Karlsruhe, Inst. Appl. Phys.; Univ. Frankfurt, Inst. Theor. Phys., FRG. 83-2392
0	12	21	33 (10)	**Klinowski J, Thomas J M, Fyfe C A & Hartman J S.** Applications of magic-angle-spinning silicon-29 nuclear magnetic resonance. Evidence for two different kinds of silicon-aluminum ordering in zeolitic structures. *J. Phys. Chem.* 85:2590-4, 1981. Univ. Cambridge, Dept. Phys. Chem., UK; Univ. Guelph, Guelph-Waterloo Ctr. Grad. Work Chem., Ontario, Canada. 83-3408
7	19	16	42 (20)	**Knox J H & Hartwick R A.** Mechanism of ion-pair liquid chromatography of amines, neutrals, zwitterions and acids using anionic hetaerons. *J. Chromatogr.* 204:3-21, 1981. Univ. Edinburgh, Dept. Chem., UK. 82-1015, 83-0809
4	20	23	47 (24)	**Lang J K, Baer Y & Cox P A.** Study of the 4f and valence band density of states in rare-earth metals: II. Experiment and results. *J. Phys.—F—Metal Phys.* 11:121-38, 1981. ETH, Solid-State Phys. Lab., Zurich, Switzerland; Univ. Oxford, Dept. Inorg. Chem., UK. 82-0411
2	15	16	33 (10)	**Legon A C, Aldrich P D & Flygare W H.** The rotational spectrum and molecular structure of the acetylene-HCl dimer. *J. Chem. Phys.* 75:625-30, 1981. Univ. Illinois, Noyes Chem. Lab., Urbana, IL. *83-0208
0	13	25	38 (15)	**Liao P F, Bergman J G, Chemla D S, Wokaun A, Melngailis J, Hawryluk A M & Economou N P.** Surface-enhanced Raman scattering from microlithographic silver particle surfaces. *Chem. Phys. Lett.* 82:355-9, 1981. Bell Tel. Labs., Holmdel, NJ; MIT, Res. Lab. Electron., Cambridge & Lincoln Labs., Lexington, MA. 83-2981
3	17	38	58 (38)	**Logan J A, Prather M J, Wofsy S C & McElroy M B.** Tropospheric chemistry: a global perspective. *J. Geophys. Res. C—Oceans Atmos.* 86:7210-54, 1981. Harvard Univ., Ctr. Earth Planet. Phys., Cambridge, MA. 83-8298
3	16	17	36 (20)	**Macura S, Huang Y, Suter D & Ernst R R.** Two-dimensional chemical exchange and cross-relaxation spectroscopy of coupled nuclear spins. *J. Magn. Resonance* 43:259-81, 1981. ETH, Lab. Phys. Chem., Zurich, Switzerland. 82-0665
5	26	23	54 (12)	**McClelland G M, Kubiak G D, Rennagel H G & Zare R N.** Determination of internal-state distributions of surface scattered molecules: incomplete rotational accommodation of NO on Ag(111). *Phys. Rev. Lett.* 46:831-4, 1981. Stanford Univ., Dept. Chem., CA. 82-2123, 83-4161
0	9	26	35 (17)	**Meek J L & Rossetti Z L.** Factors affecting retention and resolution of peptides in high-performance liquid chromatography. *J. Chromatogr.* 211:15-28, 1981. NIMH, St. Elizabeth's Hosp., Washington, DC. *83-2525
6	14	16	36 (19)	**Mele E J & Rice M J.** Semiconductor-metal transition in doped polyacetylene. *Phys. Rev. B—Condensed Matter* 23:5397-412, 1981. Xerox Webster Res. Ctr., NY. 82-0832
2	13	26	41 (14)	**Muller A, Diemann E, Jostes R & Bogge H.** Transition metal thiometalates: properties and significance in complex and bioinorganic chemistry. *Angew. Chem. Int. Ed.* 20:934-55, 1981. Univ. Bielefeld, Fac. Chem., FRG. 83-3808
7	12	13	32 (5)	**Murani A P.** Spectral distribution of relaxation times in spin glasses. *J. Magn. Magn. Mater.* 22:271-81, 1981. Max Von Laue-Paul Langevin Inst., Grenoble, France. 83-1782
8	16	10	34 (8)	**Murray C A, Allara D L & Rhinewine M.** Silver-molecule separation dependence of surface-enhanced Raman scattering. *Phys. Rev. Lett.* 46:57-60, 1981. Bell Labs., Murray Hill, NJ. *83-0108
8	14	16	38 (18)	**Nahum A & Horvath C.** Surface silanols in silica-bonded hydrocarbonaceous stationary phases. I. Dual retention mechanism in reversed-phase chromatography. *J. Chromatogr.* 203:53-63, 1981. Yale Univ., Dept. Eng. Appl. Sci., New Haven, CT. *83-1015

A	B	C	D	E
2	16	27	45 (42)	**Nigrey P J, MacInnes D, Nairns D P, MacDiarmid A G & Heeger A J.** Lightweight rechargeable storage batteries using polyacetylene, $(CH)_x$ as the cathode-active material. *J. Electrochem. Soc.* 128:1651-4, 1981. Univ. Pennsylvania, Depts. Chem. & Phys., Philadelphia, PA. *83-3010
1	21	43	65 (49)	**Noid D W, Koszykowski M L & Marcus R A.** Quasiperiodic and stochastic behavior in molecules. *Annu. Rev. Phys. Chem.* 32:267-309, 1981. Oak Ridge Natl. Lab., TN.; Sandia Natl. Labs., Livermore; Caltech., Pasadena, CA. 82-1303, 82-2618
0	16	22	38 (6)	**Parkin S S P, Ribault M, Jerome D & Bechgaard K.** Superconductivity in the family of organic salts based on the tetramethyltetraselenafulvalene (TMTSF) molecule: $(TMTSF)_2X(X=ClO_4, PF_6, AsF_6, SbF_6, TaF_6)$. *J. Phys.—C—Solid State Phys.* 14:5305-26, 1981. Univ. Paris XI, Lab. Phys. Solid-State, Orsay, France; H.C. Oersted Inst., Copenhagen, Denmark. 83-2192
1	18	29	48 (32)	**Patel C K N & Tam A C.** Pulsed optoacoustic spectroscopy of condensed matter. *Rev. Mod. Phys.* 53:517-50, 1981. Bell Labs., Murray Hill, NJ; IBM, Res. Lab., San Jose, CA. 83-0006
0	18	23	41 (36)	**Paul W & Anderson D A.** Properties of amorphous hydrogenated silicon, with special emphasis on preparation by sputtering. *Solar Energ. Mater.* 5:229-316, 1981. Harvard Univ., Div. Appl. Sci., Cambridge, MA. 82-1430, 83-6268
8	19	14	41 (26)	**Phillips J C.** Topology of covalent non-crystalline solids II: medium-range order in chalcogenide alloys and A-Si(Ge). *J. Non-Cryst. Solids* 43:37-77, 1981. Bell Labs., Murray Hill, NJ. 82-3032, 83-1467
3	10	19	32 (10)	**Ploog K, Fischer A & Kunzel H.** The use of Si and Be impurities for novel periodic doping structures in GaAs grown by molecular beam epitaxy. *J. Electrochem. Soc.* 128:400-10, 1981. Max Planck Inst. Solid-State Res., Stuttgart, FRG. 83-5401
4	23	16	43 (8)	**Ranger C B.** Flow injection analysis. *Anal. Chem.* 53:20A-32A, 1981. Lachat Chem. Inc., Instrum. Div., Mequon, WI. 82-1002, 83-2485
0	11	28	39 (24)	**Roler-DePoorter C K.** A comprehensive mechanism for the Fischer-Tropsch synthesis. *Chem. Rev.* 81:447-74, 1981. Univ. California, Los Alamos Natl. Lab., NM. 83-1064
5	23	19	47 (17)	**Rubloff G W, Ho P S, Freeouf J F & Lewis J E.** Chemical bonding and reactions at the Pd/Si interface. *Phys. Rev. B—Condensed Matter* 23:4183-96, 1981. IBM, Thomas J. Watson Res. Ctr., Yorktown Heights, NY. 82-2120
2	22	34	58 (26)	**Schuetzle D, Lee F S-C, Prater T J & Tejada S B.** The identification of polynuclear aromatic hydrocarbon (PAH) derivatives in mutagenic fractions of diesel particulate extracts. *Int. J. Environ. Anal. Chem.* 9:93-144, 1981. Ford Motor Co., Eng. Res. Staff-Res., Dearborn, MI; US EPA, Environ. Sci. Res. Lab., Research Triangle Park, NC. 82-2806, 83-4244
5	14	13	32 (10)	**Schultz S G, Janik-Czachor M & Van Duyne R P.** Surface enhanced Raman spectroscopy: a re-examination of the role of surface roughness and electrochemical anodization. *Surface Sci.* 104:419-34, 1981. Northwestern Univ., Dept. Chem., Evanston, IL.
0	23	18	41 (21)	**Skotheim T, Lundstrom I & Prejza J.** Stabilization of n-Si photoanodes to surface corrosion in aqueous electrolyte with a thin film of polypyrrole. *J. Electrochem. Soc.* 128:1625-6, 1981. Linkoping Inst. Technol., Lab. Appl. Phys., Sweden. 82-1104
0	15	26	41 (52)	**Street R A.** Luminescence and recombination in hydrogenated amorphous silicon. *Advan. Phys.* 30:593-676, 1981. Xerox Palo Alto Res. Ctr., CA. 83-5557
3	12	20	35 (15)	**Tu Y-Y, Chuang T J & Winters H F.** Chemical sputtering of fluorinated silicon. *Phys. Rev. B—Condensed Matter* 23:823-35, 1981. IBM, Res. Lab., San Jose, CA; Odense Univ., Phys. Inst., Denmark. 83-3926
0	15	18	33 (9)	**Upton T H & Goddard W A.** Evidence for two states of chemisorbed oxygen on Ni(100). *Phys. Rev. Lett.* 46:1635-9, 1981. Exxon Res. Eng. Co., Corp. Res.-Sci. Labs., Linden, NJ; Caltech., Arthur Amos Noyes Lab. Chem. Phys., Pasadena, CA. 83-5245
0	13	22	35 (13)	**VanderHart D L, Earl W L & Garroway A N.** Resolution in ^{13}C NMR of organic solids using high-power proton decoupling and magic-angle sample spinning. *J. Magn. Resonance* 44:361-401, 1981. NBS, Ctrs. Mater. Res. & Fire Res.; USN, Naval Res. Lab., Washington, DC. 83-0917
5	14	13	32 (8)	**Veprek S, Iqbal Z, Oswald H R & Webb A P.** Properties of polycrystalline silicon prepared by chemical transport in hydrogen plasma at temperatures between 80 and 400°C. *J. Phys.—C—Solid State Phys.* 14:295-308, 1981. Univ. Zurich, Inst. Inorg. Chem., Switzerland. 83-7009

A	B	C	D	E
0	19	24	43 (37)	**Walsh R.** Bond dissociation energy values in silicon-containing compounds and some of their implications. *Account. Chem. Res.* 14:246-52, 1981. Univ. Reading, Dept. Chem., UK. 83-1976
0	16	16	32 (19)	**Wang D-S & Kerker M.** Enhanced Raman scattering by molecules adsorbed at the surface of colloidal spheroids. *Phys. Rev. B—Condensed Matter* 24:1777-90, 1981. Clarkson Coll. Technol., Potsdam, NY. *83-0233
1	11	37	49 (32)	**Wegner G.** Polymers with metal-like conductivity—a review of their synthesis, structure, and properties. *Angew. Chem. Int. Ed.* 20:361-81, 1981. Albert Ludwigs Univ. Freiburg, Inst. Macromol. Chem., FRG. 83-2093
2	9	25	36 (11)	**Wetzel H, Gerischer H & Pettinger B.** Surface enhanced Raman scattering from silver-halide and silver-pyridine vibrations and the role of silver ad-atoms. *Chem. Phys. Lett.* 78:392-7, 1981. Max Planck Soc. Adv. Sci., Fritz Haber Inst., Berlin, FRG. 83-2981
6	11	15	32 (10)	**Willey C, Iwao M, Castle R N & Lee M L.** Determination of sulfur heterocycles in coal liquids and shale oils. *Anal. Chem.* 53:400-7,1981. Brigham Young Univ., Dept. Chem., Provo, UT. 83-5913
1	12	22	35 10)	**Williams R H.** Surface detect effects on Schottky barriers. *J. Vac. Sci. Technol.* 18:929-36, 1981. Univ. Ulster, Sch. Phys. Sci., Coleraine, N. Ireland, UK. 83-0866
3	14	23	40 (16)	**Williamson S J & Kaufman L.** Biomagnetism. *J. Magn. Magn. Mater.* 22:129-201, 1981. New York Univ., Depts. Phys. & Psychol., New York, NY. 83-1780
6	13	14	33 (18)	**Wronski C R & Daniel R E.** Photoconductivity, trapping, and recombination in discharge-produced, hydrogenated amorphous silicon. *Phys. Rev. B—Condensed Matter* 23:794-804, 1981. RCA Labs., Princeton, NJ. 83-0507
2	13	21	36 (14)	**Yin M T & Cohen M L.** Theoretical determination of surface atomic geometry: Si(001)-(2 x 1). *Phys. Rev. B—Condensed Matter* 24:2303-6, 1981. Univ. California, Dept. Phys. & Lawrence Berkeley Lab., Berkeley, CA. *83-0417

Table 2: The 1982 *SCI*® and 1983 *SCI/SSCI*® research fronts that contain at least two of the papers in Table 1. A = number. B = name. C = number of 1981 most-cited chemistry papers included in the core of each research front. D = total number of core documents/1982 or 1983 papers citing the core (according to the year of the front designated by the prefix in column A).

A	B	C	D
82-0665	Information content of two-dimensional Fourier spectroscopy; proton, P-31 and C-13 NMR and nuclear Overhauser effect	2	26/257
82-0832	Electronic properties of polyacetylene	2	39/299
82-1040	Kinetic theory and constitutive equations for polymer melts and other polymeric liquids	2	9/89
82-1104	Electronic properties of polypyrrole and other conducting polymers; use of conducting polymers in semiconductor photoelectrodes for solar energy conversion	2	12/126
82-2123	Rotationally inelastic scattering of nitric oxide and other gases from solid surfaces	3	3/28
82-2319	Preparation and separation performance of polysiloxane and other stationary phases for gas chromatography	2	2/26
83-0809	Analysis of nucleotides, bile acids and aromatic compounds using reversed-phase or ion-pair high-performance liquid chromatography	2	15/128
83-1064	Fischer-Tropsch synthesis of hydrocarbons and alcohols via the hydrogenation of carbon monoxide on supported iron catalysts	2	35/376
83-1380	Structural assignment and other aspects of multinuclear two-dimensional nuclear magnetic resonance spectroscopy	5	59/541
83-2813	Diffusion and flow dynamics in polystyrene and other viscoelastic polymer melts	2	12/184
83-2981	Theory and observation of surface-enhanced Raman scattering from pyridine and other adsorbed species on silver surfaces	3	14/194
83-3408	Characterization of the aluminum-silicon distribution in zeolites using high-resolution solid-state silicon-29 and aluminum-27 nuclear magnetic resonance spectroscopy	2	16/110
83-4161	Theoretical and experimental studies of rotational scattering from surfaces	3	5/49

front numbers are listed after their corresponding papers in Table 1. In addition, *CCI* research-front numbers are also provided for those papers that do not appear in *SCI* fronts. Only one of these *CCI* fronts includes more than one paper from Table 1 in its core. It is #83-0208, "Microwave spectroscopy, infrared and other studies of rotation in hydrogen-fluoride, hydrogen-chloride and other hydrogen-bonded complexes." It includes two papers by E.J. Campbell and colleagues and one by A.C. Legon and colleagues, all of the Noyes Chemistry Laboratory, University of Illinois, Urbana.

Unfortunately, what this study does not reveal are the long-term impacts of papers in many areas of chemistry. This bias, of course, is not restricted to chemistry. In order to take a look at long-term effects in all areas of science, we plan to report on the 30-year impacts of papers published in a single year, such as 1955. We will look at the citations that these papers received from 1955 to 1957 and then observe how many of these papers fulfilled their citation expectancies. Furthermore, we will also look at the papers that did not create much stir at first but went on to become citation superstars. But that will be the topic of a future essay.

This study includes several articles that achieved high impact quite rapidly. The paper by W. Clegg, Institute of Inorganic Chemistry, University of Göttingen, Federal Republic of Germany, is the most-cited article in the list. It received 96 citations from 1981 to 1983 and another 59 citations in 1984. Clegg's article describes a modified version of an older method used in inorganic chemistry. This modified procedure increases the rate at which data are collected, without loss of precision, in a learnt-profile analysis of X-ray reflections.[4]

Three papers by first authors P.E. Garrou, Dow Chemical, Wayland, Massachusetts; M. Grätzel, École Polytechnique Fédérale, Lausanne, Switzerland; and D.W. Noid, Oak Ridge National Laboratory, Tennessee, all have 65 citations each, the second highest number of citations in Table 1. These papers discuss such diverse topics as NMR parameters of transition-metal–phosphorus chelate complexes, quasiperiodic and stochastic behavior in molecules, and artificial photosynthesis. Artificial photosynthesis, the forced decomposition of water into hydrogen and oxygen by solar radiation, has potential as an alternative energy source to fossil fuels. To aid this process, researchers are currently attempting to design and develop microscopic units that would mimic the function of chloroplasts in natural photosynthesis.[5] Grätzel's paper discusses the use of colloidal semiconductors, molecular assemblies, and redox catalysts to accomplish light-induced water cleavage.[5] It is a core paper in research front #83-6785, "Photochemical processes in micellar and colloidal systems in aqueous-solution," which is made up of 95 citing papers. According to Grätzel, the literature in this field has grown astonishingly over the last 20 years.[5]

All three of the papers mentioned above continued to be well cited in 1984. Each received between 40 and 60 citations that year. Note that the citation counts in this second part of the study are higher than the counts for the papers in Part 1. The average number of citations from 1981 to 1983 in Part 1 was 34; in Part 2 it is over 40. Furthermore, the most-cited paper in Part 1 had 56 citations and the least-cited article had 25, compared to 96 and 32 citations here.

While citation counts are one measure that may be used to judge the relative impact of papers, individuals are sometimes judged by the number of papers that they have published. By itself, this is a somewhat tenuous measure of productivity. In this list, one author, W.H. Flygare, Noyes Chemistry Laboratory, University of Illinois, Urbana, coauthored four papers,[6-9] three with T.J. Balle and other researchers from Urbana. These three papers describe the use of the Fabry-Perot cavity microwave spectrometer. Flygare died in 1981 at the age of 44 shortly after publishing the papers listed here. During his 20-year tenure at the University of Illinois, he produced over 200 research publications including a 1978 treatise on molecular structure and dynamics.[10] Two authors from Part 1 of the study also coauthored four papers—Grätzel of Switzerland, mentioned above, and P.V.R. Schleyer, Friedrich-Alexander University, Erlangen, Federal Republic of Germany. Several researchers from Part 1 also authored three papers (M. Barber, R.S. Bordoli, D.A. Evans, R. Noyori, R.R. Schrock, and R.D. Sedgwick).

A. Bax, Physical Chemistry Laboratory, University of Oxford, UK, authored three papers in this listing that were published in the *Journal of Magnetic Resonance*. In fact, this journal accounts for seven papers in the list as compared with eight each published in the *Journal of Chemical Physics*, *Physical Review B—Condensed Matter*, and *Physical Review Letters*. These are shown in Table 3, which includes the 18 periodicals out of 40 in this essay that published 2 or more of the 100 articles. Seven journals published almost 50 percent of the papers. Most of these journals are in physical chemistry and chemical physics. The journal with the highest 1981 impact factor (the average number of citations received by a journal's 1979 and 1980 articles in 1981) is *Reviews of Modern Physics* (16.2).

In Table 4 we have listed the 77 institutions involved in Part 2 of this study. They are summarized by university or corporation only. The University of Wisconsin heads the list, followed by the University of California and Bell Laboratories. To give the reader a better idea of the departments and laboratories that contributed these papers, I have listed here some of those that appeared most often. For example, four papers are from the Noyes Chemistry Laboratory,

Table 3: The journals that published at least two papers in Table 1. Each journal's 1981 impact factor follows in parentheses. Data were taken from the 1981 *JCR*™. The figures at the right indicate the number of papers from each journal that appears in the list.

Journal	Number of Papers
J. Chem. Phys. (3.03)	8
Phys. Rev. B—Condensed Matter (2.94)	8
Phys. Rev. Lett. (6.06)	8
J. Magn. Resonance (1.71)	7
J. Chromatogr. (1.83)	6
Account. Chem. Res. (9.07)	5
Angew. Chem. Int. Ed. (4.11)	5
Chem. Phys. Lett. (1.99)	4
J. Electrochem. Soc. (1.86)	4
Surface Sci. (3.51)	4
Chem. Rev. (10.58)	3
J. Phys.—C—Solid State Phys. (2.51)	3
J. Phys. Chem. (2.17)	3
Advan. Phys. (8.71)	2
Anal. Chem. (2.80)	2
Annu. Rev. Phys. Chem. (5.91)	2
J. Magn. Magn. Mater. (0.89)	2
Rev. Mod. Phys. (16.23)	2

Table 4: Authors' institutional affiliations in descending order of the number of times they appear in Table 1.

Univ. Wisconsin, Madison		9
Univ. California		8
Berkeley	6	
Los Alamos, NM	1	
Santa Barbara	1	
Bell Labs, NJ		7
Murray Hill	6	
Holmdel	1	
Univ. Cambridge, UK		6
Univ. Illinois, Urbana		5
Caltech, Pasadena, CA		4
ETH, Switzerland		4
Dubendorf	2	
Zurich	2	
IBM		4
Res. Lab., San Jose, CA	3	
Thomas J. Watson Res. Ctr., Yorktown Heights, NY	1	
Max Planck Soc. Adv. Sci., FRG		4
Fritz Haber Inst., Berlin	1	
Inst. Biophys. Chem., Gottingen-Nikolausberg	1	
Inst. Solid-State Phys., Stuttgart	1	
Laser Res. Project Grp., Garching	1	
Univ. Oxford, UK		4
Univ. Pennsylvania, Philadelphia		4
Stanford Univ., CA		3
Harvard Univ., Cambridge, MA		2
MIT, MA		2
Cambridge	1	
Lexington	1	

NBS, Washington, DC	2
New York Univ., NY	2
Univ. Munich, FRG	2
Xerox	2
Palo Alto, CA	1
Webster, NY	1
Yale Univ., New Haven, CT	2
Albert Ludwigs Univ. Freiburg, FRG	1
Battelle Mem. Inst., Columbus, OH	1
Brigham Young Univ., Provo, UT	1
Clarkson Coll. Technol., Potsdam, NY	1
CNR, Rome, Italy	1
CNRS, Villeurbanne, France	1
Coll. William and Mary, Williamsburg, VA	1
Ctr. Etudes Nucl. Grenoble, France	1
Dow Chem., Wayland, MA	1
Ecole Polytech. Fed., Lausanne, Switzerland	1
Exxon Res. Eng. Co., Linden, NJ	1
Ford Motor Co., Dearborn, MI	1
Griffith Univ., Nathan, Australia	1
H.C. Oersted Inst., Copenhagen, Denmark	1
Hoffmann-La Roche, Inc., Nutley, NJ	1
Johannes Gutenberg Univ. Mainz, FRG	1
KabiGen AB, Stockholm, Sweden	1
Kantonales Lab., Zurich, Switzerland	1
Lachat Chem. Inc., Mequon, WI	1
Linkoping Inst. Technol., Sweden	1
Marburg Univ., FRG	1
Max Von Laue-Paul Langevin Inst., Grenoble, France	1
Natl. Res. Ctr. Canada, Ottawa	1
NIMH, Washington, DC	1
Northwestern Univ., Evanston, IL	1
Oak Ridge Natl. Labs., TN	1
Odense Univ., Denmark	1
RCA Labs., Princeton, NJ	1
Rheinische Friedrich-Wilhelms Univ., Bonn, FRG	1
Rockwell Intl., Thousand Oaks, CA	1
Royal Inst. Great Britain, London, UK	1
*Sandia Natl. Labs., Livermore, CA	1
Shell Res. BV, Amsterdam, the Netherlands	1
Solar Energy Res. Inst., Golden, CO	1
Tel-Aviv Univ., Israel	1
Tubigen Univ., FRG	1
Univ. Alberta, Edmonton, Canada	1
Univ. Bielefeld, FRG	1
Univ. Chicago, IL	1
Univ. Colorado, Denver	1
Univ. Edinburgh, UK	1
Univ. Frankfurt, FRG	1
Univ. Gottingen, FRG	1
Univ. Guelph, Ontario, Canada	1
Univ. Hawaii, Honolulu	1
Univ. Hull, UK	1
Univ. Karlsruhe, FRG	1
Univ. Modena, Italy	1
Univ. N. Carolina, Chapel Hill	1
Univ. Paris XI, Orsay, France	1
Univ. Reading, UK	1
Univ. Southampton, UK	1
Univ. Texas, Austin	1
+Univ. Ulster, Coleraine, N. Ireland, UK	1
Univ. Washington, Seattle	1
Univ. Zurich, Switzerland	1
US EPA, Research Triangle Park, NC	1
USN, Washington, DC	1

*Component of the US Dept. of Energy
+Previous to 1981 was New Univ. Ulster

University of Illinois, Urbana, named after William Albert Noyes, the founder of *Chemical Abstracts*. However, the Noyes Laboratory of Chemical Physics at the California Institute of Technology, Pasadena, is named after Arthur Amos Noyes, the Massachusetts chemist famous for his work in thermodynamic chemistry, ionic theory, and qualitative analysis. Two papers from this lab appear in Table 1. Incidentally, William and Arthur Noyes are not related. Several other laboratories or departments each accounted for three papers, including the Lawrence Berkeley Laboratory at the University of California and the University of Oxford's Physical Chemistry Laboratory. The Physical Chemistry Department at the University of Cambridge published three papers, one with the university's chemistry lab, which published an additional two papers independently. In addition, the Department of Chemical Engineering at the University of Wisconsin appeared three times.

Table 5 demonstrates that the 235 authors in this study are an international

Table 5: National affiliations of the authors of the papers in Table 1, in order of the total number of papers in which each nation's authors appeared (column A). B = number of papers coauthored with scientists affiliated with other countries. C = national affiliation of coauthors.

Country	A	B	C
US	57	1	Denmark
UK	15	3	Canada, Switzerland
FRG	12		
Switzerland	6	1	UK
France	4	1	Denmark
Canada	3	2	UK
Denmark	2	2	France, US
Sweden	2		
Australia	1		
Israel	1		
Italy	1		
the Netherlands	1		

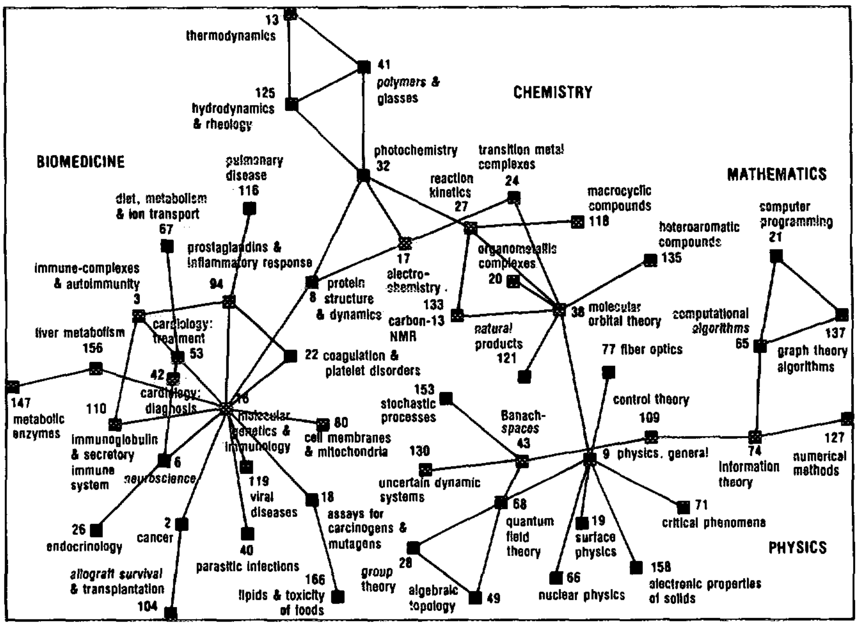
group. Although 12 countries are represented, all 100 papers were published in English. Over half of the papers had US addresses, while 14 percent were from the UK, 11 percent from the Federal Republic of Germany, and 6 percent from Switzerland. France and Canada were represented four and three times each, respectively, while Denmark and Sweden each appeared twice. The following countries were each listed once—Australia, Israel, Italy, and the Netherlands. The Israeli article is the only one from that country that has appeared in this study. It was authored by a group of researchers from the Department of Chemistry, Tel-Aviv University, and describes excited-state dynamics of the isolated ultracold ovalene molecule. Japan is conspicuously absent from Table 5 in contrast to Part 1 where it accounted for 10 percent of the papers.

Multi-authored works are common in these studies—one article in Table 1 had eight authors, another one had seven, and one had five. Twenty papers had four authors, while 25 had three, and 30 had two. In this era of team research, it is surprising that 22 percent were single-author papers. Only 12 papers in Part 1 of this chemistry study were single-author works.

Three authors in Part 1 of this study won Nobel Prizes. Only one turned up in Part 2. Arthur L. Schawlow, Stanford University, shared the 1981 award in physics with Nicolaas Bloembergen (US) and Kai M. Siegbahn (Sweden) for developing laser technologies and other devices to probe the secrets of complex forms of matter.[11] One modern use of lasers is for surgery, a topic that we discussed recently.[12] Schawlow coauthored a paper in Table 1 with N.W. Carlson, A.J. Taylor, and K.M. Jones, Department of Physics, Stanford University.

This concludes our discussion of the 1981 chemistry papers most cited from 1981 to 1983. We have discussed more papers in this two-part study than in previous similar analyses. In doing so, we

Figure 1: Multi-dimensional scaling map of the natural sciences for 1983. Serial numbers are for identification only. Lines between nodes represent co-citation strength, an indicator of semantic distance.



have called attention to the many diverse specialties subtended by the often vague and general discipline we call chemistry. This is perhaps best illustrated by including here a map of biomedical and physical sciences that I recently used to illustrate a talk for mapping the world of chemistry. (See Figure 1.) As a follow-up, my bibliographic assistants are preparing the list of 1982 chemistry papers most cited from 1982 to 1984, so that these can be reviewed later this year.

APPENDIX

For those readers interested in the detailed differences between *SCI* and *CCI* research fronts, refer to previous essays on clustering,[13,14] as well as Part 1 of this study. By narrowing the list of journals included in a file or by changing the number of years covered, we can increase the number and specificity of the fronts we identify. There is an almost unlimited number of topics one could identify. For 1983 we identified about 10,000 fronts for a combined *SCI/SSCI* file. As can be seen in the map provided in Figure 1, chemistry provides a central and connecting link between the life and physical sciences.

* * * * *

My thanks to Abigail Grissom and Gillian Wilson for their help in the preparation of this essay.

REFERENCES

1. **Garfield E.** The 1981 most-cited chemistry papers. Part 1. Pure and synthetic chemistry. Or, should I say, most-cited papers published in 1981 in the *Journal of the American Chemical Society*? *Current Contents* (12):3-16, 25 March 1985.
2. --------------. The 1981 articles most cited in 1981 and 1982. 1. Life sciences. 2. Physical sciences. *Essays of an information scientist.* Philadelphia: ISI Press, 1984. Vol. 6. p. 301-11; 373-83. (Reprinted from: *Current Contents* (38):3-13, 19 September 1983; (46):3-13, 14 November 1983.)
3. **Brey W.** Personal communication. 5 August 1985.
4. **Clegg W.** Faster data collection without loss of precision. An extension of the learnt profile method. *Acta Crystallogr. A* 37:22-8, 1981.
5. **Grätzel M.** Artificial photosynthesis: water cleavage into hydrogen and oxygen by visible light. *Account. Chem. Res.* 14:376-84, 1981.
6. **Balle T J & Flygare W H.** Fabry-Perot cavity pulsed Fourier transform microwave spectrometer with a pulsed nozzle particle source. *Rev. Sci. Instr.* 52:33-45, 1981.
7. **Campbell E J, Buxton L W, Balle T J & Flygare W H.** The theory of pulsed Fourier transform microwave spectroscopy carried out in a Fabry-Perot cavity: static gas. *J. Chem. Phys.* 74:813-28, 1981.
8. **Campbell E J, Buxton L W, Balle T J, Keenan M R & Flygare W H.** The gas dynamics of a pulsed supersonic nozzle molecular source as observed with a Fabry-Perot cavity microwave spectrometer. *J. Chem. Phys.* 74:829-40, 1981.
9. **Legon A C, Aldrich P D & Flygare W H.** The rotational spectrum and molecular structure of the acetylene-HCl dimer. *J. Chem. Phys.* 75:625-30, 1981.
10. **Chandler D & Drickamer H G.** Willis H. Flygare. (Obituary.) *Phys. Today* 34(9):114-5, 1981.
11. Awards: Nobel Prizes. *Information Please Almanac 1983.* New York: A&W, 1982. p. 530.
12. **Garfield E.** Journal citation studies. 45. Surgery journals: another operation in citation analysis. *Current Contents* (21):3-18, 27 May 1985.
13. --------------. *Index Chemicus* goes online with graphic access to three million new organic compounds. *Essays of an information scientist: the awards of science and other essays.* Philadelphia: ISI Press, 1985. Vol. 7. p. 194-202.
14. --------------. ABCs of cluster mapping. Parts 1&2. Most active fields in the life and physical sciences in 1978. *Essays of an information scientist.* Philadelphia: ISI Press, 1981. Vol. 4. p. 634-49.