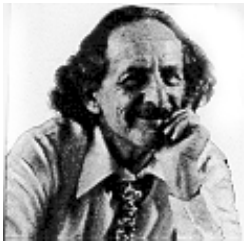
Essays of an Information Scientist, Vol:8, p.497-511, 1985
Current Contents, #51-52, p.3-17, December 23-30, 1985



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The 1982 Chemistry Articles Most Cited, 1982-1984

Numbers 51-52 December 23-30, 1985

This is the third annual *Current Contents*® (*CC*®) study on most-cited chemistry papers. To date we have examined articles from 1980 and 1981 that were cited over a three-year period.[1,2] This analysis discusses the 1982 chemistry papers from the *Chemistry Citation Index*™ (*CCI*™), a subset of the *Science Citation Index*® (*SCI*®). These papers were most cited from 1982 to 1984.

The *CCI* is a new ISI® database that is not yet available in print or online. A more complete description of it can be found in *CC* essays from June 25, 1984,[3] and March 25, 1985.[2] Earlier this year we used it, along with *Current Abstracts of Chemistry and Index Chemicus*® (*CAC&IC*®), to help identify the most-cited 1981 "chemistry" papers.[2] In that two-part study we first used the source journals covered by *CAC&IC* to identify 103 articles, primarily in pure and synthetic chemistry. A second list of 100 papers, based on the *CCI*, filled in those other areas of chemistry covering physical, inorganic, organic, spectroscopic, and analytical chemistry.

For the present analysis we used the *CCI* to identify 105 1982 papers. (See Bibliography.) During this process we eliminated any papers from biochemistry or other fields already covered by our annual studies of the life and physical sciences. The borderlines between fields are not always easily identified. Modern chemistry touches many subdisciplines intertwined with biochemistry or physics. However, each iteration of this selection process identifies significant papers from a wide variety of areas.

Journals

The 39 journals that published the 105 papers are listed in Table 1. They encompass many different areas of chemistry and confirm, in part, that the list in the Bibliography is quite varied. The *Journal of the American Chemical Society* (*JACS*), which dominated the first list of 1981 papers, published the largest number of papers in this study—21. But this is less than one-third of the 74 *JACS* papers in that 1981 group. It is also less than the number of *JACS* papers (35) published in the 1980 study.

Analytical Chemistry has the second greatest number of articles in the Bibliography (nine), followed by *Accounts of Chemical Research* (six), the *Journal of Chemical Physics* (six), and the *Journal of Physical Chemistry* (six). These five journals account for almost 50 percent of the papers in the Bibliography. We will discuss the latter two in an upcoming essay on physical chemistry/chemical physics journals. But the *Journal of Physical Chemistry*, which has six papers in this listing, had only three in both lists in the 1981 study and none at all in the 1980 analysis. *Science*, which published seven papers in 1981, has just three papers here.

One new journal appears in Table 1. *Organometallics*, established in 1982 by the American Chemical Society, covers the synthesis of organometallic compounds, their structure and bonding, chemical reactivity and reaction mechanisms, and applications. The journal defines an organometallic compound as

one "in which there is a bonding interaction (ionic or covalent, localized or delocalized) between one or more carbon atoms of an organic group or molecule and a main group, transition lanthanide, or actinide metal atom (or atoms)."[4] *Organometallics* published one paper in this study authored by David L. Thorn, Central Research and Development Department, Dupont Company, Wilmington, Delaware.

Heterocycles, an international review journal published in English by the Sendai Institute of Heterocyclic Chemistry, Sendai, Japan, is also represented for the first time in one of these most-cited lists. Yoshinori Yamamoto and Kazuhiro Maruyama, Department of Chemistry, Kyoto University, Japan, discuss "Organometallic compounds for stereoregulated synthesis of acyclic systems. Their application to the synthesis of the Prelog-Djerassi lactonic acid."

The Prelog-Djerassi lactone has frequently been discussed in papers that appear in our lists of highly cited articles. As it happens, Vladimir Prelog, Laboratory of Organic Chemistry, Swiss Federal Institute of Technology, Zurich, Switzerland, coauthored a new methodological paper in this study with first author Dieter Seebach, also of the Swiss Federal Institute of Technology. Entitled "The unambiguous specification of the steric course of asymmetric syntheses," the paper was published in *Angewandte Chemie—International Edition in English*. Since this journal is published in both German- and English-language editions, we unified any citations to papers published in both versions. The Seebach-Prelog paper has received 57 citations since 1982, including 19 in 1985 alone. According to the authors, "The nomenclature of organic chemistry has not kept pace with the staggering advances made in asymmetric synthesis over the last 15 years. Efforts to specify the steric course of stereoselective reactions by use of the terms *erythro* and *threo* and by other descriptors have led to ambiguous notation and consequently to [utter] confusion. We propose...a method...for the unambiguous specification of the steric course and the product configuration of diastereoselective reactions."[5]

Nobelists

Prelog is one of three Nobel authors in this study. He was awarded the prize in 1975 with John W. Cornforth (Australia and UK) for their work on stereochemistry, specifically for investigating the structure of biological molecules such as antibiotics and cholesterol. Sir George Porter (UK), who authored a paper in the Bibliography with James R. Darwent and colleagues, Davy Faraday Research Laboratory, The Royal Institute, London, shared the 1967 prize with Manfred Eigen, (Federal Republic of Germany [FRG]), and Ronald G.W. Norrish (UK) for investigating high-speed chemical reactions. The third Nobelist is Roald Hoffmann (US), whose work has appeared often in these lists. He was honored by the Nobel committee in 1981 with Kenichi Fukui (Japan). Hoffmann is represented in the Bibliography by two papers, one of which is his Nobel acceptance lecture, "Building bridges between inorganic and organic chemistry." Hoffmann dedicated this lecture to his former teacher, Robert B. Woodward, Harvard University, Cambridge, Massachusetts, whom he considered "a supreme patterner of chaos."[6] Woodward won the Nobel Prize for chemistry in 1965.

Geographical and Institutional Affiliations

I mentioned earlier that Japan published one journal in this study (*Heterocycles*). The paper in the Bibliography from that journal was written by Japanese researchers. "Only" two additional papers in the Bibliography are from Japanese institutions. In contrast, Japan was represented by 11 articles in the 1981 study. All of those papers appeared in Part 1 of that analysis where *JACS* dominated the list. Seventy papers in this study have US institutional addresses, while papers from Canadian institu-

Table 1: *The 39 journals that published the 105 1982* chemistry papers most cited in the *SCI®*, 1982-1984. The numbers in parentheses are the 1982 impact factors for the journals. (The 1982 impact factor equals the number of 1982 citations received by the 1980-1981 articles in a journal, divided by the number of articles published by the journal during the same period.) Data were taken from the 1982 *JCR®*. The figures at the right indicate the number of papers from each journal that appear in the Bibliography.

Journal	Number of Papers
J. Amer. Chem. Soc. (4.72)	21
Anal. Chem. (3.71)	9
Account. Chem. Res. (9.02)	6
J. Chem. Phys. (2.95)	6
J. Phys. Chem. (2.44)	6
Angew. Chem. Int. Ed. (4.17)	4
Phys. Rev. B—Condensed Matter (3.02)	4
Annu. Rev. Phys. Chem. (7.26)	3
Chem. Rev. (7.59)	3
J. Electroanal. Chem. (2.15)	3
Pure Appl. Chem. (2.03)	3
Science (6.81)	3
J. Chromatogr. (2.00)	2
J. Magn. Resonance (2.22)	2
J. Org. Chem. (2.10)	2
Nature (8.75)	2
Nucl. Acid. Res. (6.96)	2
Tetrahedron (1.74)	2
Tetrahedron Lett. (2.03)	2
Astrophys. J. Suppl. Ser. (---)	1
Can. J. Chem. (1.18)	1
Chem. Phys. Lett. (2.19)	1
Coord. Chem. Rev. (3.82)	1
Geochim. Cosmochim. Acta (3.06)	1
Helv. Chim. Acta (1.76)	1
Heterocycles (1.10)	1
Inorg. Chem. (2.90)	1
Int. J. Mass Spectrom. Ion Phys. (1.81)	1
Int. J. Chem. Kinet. (1.43)	1
J. Chem. Soc. Faraday Trans. II (1.64)	1
J. Comput. Chem. (2.16)	1
J. Organometal. Chem. (2.13)	1
J. Phys. Chem. Ref. Data (3.10)	1
J. Phys.—F—Metal Phys. (2.26)	1
Mol. Cryst. Liquid Cryst. (1.16)	1
Organometallics (---)	1
Phys. Rev. Lett. (6.20)	1
Surface Sci. (3.59)	1
Talanta (1.40)	1

tions rank second with 10 papers. These figures have not changed much from the two previous studies. Eight papers with UK affiliations appear in the Bibliography, followed by seven articles with authors from institutions in the FRG, six from Switzerland, five from France, three each from Australia and Japan, two from Belgium and two from Denmark, and one each from institutions in The Netherlands, Israel, and Italy.

These geographic rankings are listed in Table 2. There are many multinational institutional collaborations among the 105 papers whose national affiliations are summarized there. Six US articles were cowritten with authors from institutions in Australia, Belgium, Canada, FRG, Switzerland, and the UK. Canadian institutions appear on seven papers with authors who worked in Denmark, Italy, The Netherlands, the UK, and the US. In 1981 authors in the US and in Canada coauthored papers with five and two other nations, respectively.

Thirteen nations are represented in this study, but only two papers were written in a language other than English. The paper by Andreas Pfaltz and colleagues, Swiss Federal Institute of Technology, Zurich, and Marburg University, FRG, in *Helvetica Chimica Acta*, was published in German and concerns the structure of the porphinoid ligand system. Claude Couret's short French article appeared in *Tetrahedron Letters*.

The increase in the number of papers from institutions not well represented in

Table 2: National affiliations of the authors of the 1982 chemistry papers according to institutional affiliations. Countries are ranked in descending order of the total number of papers from that country's institutions (column A). B = number of papers coauthored with researchers affiliated with other countries. C = national institutional affiliations of coauthors.

Country	A	B	C
US	70	6	Australia, Belgium, Canada, FRG, Switzerland, UK
Canada	10	7	Denmark, Italy, The Netherlands, UK, US
UK	8	5	Canada, FRG, US
FRG	7	2	Switzerland, UK, US
Switzerland	6	2	FRG, US
France	5	0	
Australia	3	1	US
Japan	3	0	
Belgium	2	1	US
Denmark	2	1	Canada
The Netherlands	1	1	Canada
Israel	1	0	
Italy	1	1	Canada

previous studies is another interesting aspect of this analysis. North Dakota State University, Fargo, is represented for the first time in our chemistry studies, with three papers (P. Boudjouk, M.M. Francl, M.S. Gordon). The Guelph-Waterloo Centre for Graduate Work in Chemistry (GWC)[2], a collaborative and innovative program of both the University of Guelph and the University of Waterloo, Canada, contributed six articles (P. Beak, A.J. Carty, C. Douketis, C.A. Fyfe, J. Klinowski, J.M. Thomas). This center is only 10 years old but is claimed to be "one of the largest and best chemistry graduate programs in Canada."[7] Giacinto Scoles, who is a coauthor on the paper by Constantine Douketis, was the acting director of the center in the year of its foundation. Arthur J. Carty was the center's first director from 1975 to 1979. Its current director is R.J. Balahura. Griffith University, Nathan, Australia, is also a relative newcomer to these lists. (See paper by D.T. Pegg and colleagues.)

These 10 papers range in citations from 35 to 77, while the most-cited paper in the study was cited 82 times and the least-cited, 35. The average citation rate for all 105 papers was 46—4 in 1982, 18 in 1983, and 24 in 1984. These figures should remind the reader that new and less familiar institutions also make important contributions to science. Traditional research giants such as MIT and the University of California, with its many campuses, usually predominate in such studies. The latter two institutions contributed 10 and 9 papers, respectively. All but three of MIT's papers are from its Department of Chemistry. The University of California research was conducted at five different departments or laboratories on six different campuses. Table 3 contains the ranked list of all 90 institutional affiliations represented in the study. (GWC)[2], mentioned above, appears on six papers. Allied Corporation in New Jersey is represented by four papers, as is Rice University, Houston, Texas; University of Toulouse III (Paul Sabatier University), France; University of Texas, Austin; and the University of Cambridge, UK.

Most-Cited Papers and Research Fronts

Researchers at an institution in Duarte, California, authored the most-cited paper in the Bibliography. Hiratake Ito, Asahi Chemical Industrial Company, Ltd., Shizuoka, Japan, worked in the Molecular Genetics Department at the City of Hope Research Institute, Duarte, for two years with colleagues Yoshimasa Ike, Satoshi Ikuta, and Keiichi Itakura. Itakura is still at the City of Hope Research Institute, while Ikuta is now at the University of California, San Diego. Ito and Ike have since returned to Japan. These four authors wrote the methodological paper in the Bibliography entitled "Solid phase synthesis of polynucleotides. VI. Further studies on polystyrene copolymers for the solid support," which was published in *Nucleic Acids Research*. It is the sixth installment in a continuing series. The eighth and most recent part appeared in 1983 in *Nucleic Acids Research*.[8] Although the title of the 1982 article and the journal that published it are life science in nature, the article's references include several to *Tetrahedron Letters* and *JACS*. According to the authors, "A simple solid phase method for the synthesis of oligodeoxyribonucleotides has been developed using the phosphotriester approach. Mononucleotide coupling units are sequentially added to the polystyrene copolymer with 1% divinylbenzene and two kinds of oligonucleotides...are synthesized in a relatively high yield."[9] In 1982, the year that the paper was published, 14 researchers cited it. In 1983 the paper received 31 citations and in 1984, 37. So far in 1985 it has been cited 19 times.

Two research fronts include Ito's paper as a core document. It is one of 31 core papers in "Methods of biosynthesis of DNA and cDNA cloning into *Escherichia coli* in the production of human insulin" (#83-0684). These 31 core papers were cited by 425 1983 papers. Two ad-

Table 3: *The institutional affiliations of the authors in the Bibliography. Institutions are listed in descending order of the number of times they appear.*

MIT, Cambridge, MA		10
Univ. California, CA		9
Berkeley	3	
Irvine	2	
Los Angeles	1	
Riverside	1	
San Francisco	1	
Santa Barbara	1	
Guelph-Waterloo Ctr. Grad. Work Chem., Ontario, Canada		6
Univ. Guelph	3	
Univ. Waterloo	3	
Allied Corp., NJ		4
Morristown	3	
Mount Bethel	1	
Rice Univ., Houston, TX		4
Univ. Cambridge, UK		4
Univ. Texas, Austin, TX		4
Univ. Toulouse III (Paul Sabatier Univ.), France		4
Bell Labs., Murray Hill, NJ		3
Caltech, Pasadena, CA		3
N. Dakota State Univ., Fargo, ND		3
Carnegie-Mellon Univ., Pittsburgh, PA		2
Cornell Univ., Ithaca, NY		2
Dow Chem. Co., Midland, MI		2
Dupont Co., Wilmington, DE		2
Ecole Polytech. Fed. Lausanne, Switzerland		2
Harvard Univ., Cambridge, MA		2
Kyoto Univ., Japan		2
Max Planck Soc. Adv. Sci., FRG		2
Berlin	1	
Mainz	1	
NBS		2
Boulder, CO	1	
Washington, DC	1	
Purdue Univ., West Lafayette, IN		2
Swiss Fed. Inst. Technol., Zurich, Switzerland		2
Univ. Alberta, Edmonton, Canada		2
Univ. Colorado, Boulder, CO		2
Univ. Illinois, Urbana, IL		2
Univ. N. Carolina, Chapel Hill, NC		2
Univ. Pennsylvania, Philadelphia, PA		2
Univ. Virginia, Charlottesville, VA		2
Varian Instrum. Grp.		2
Florham Park, NJ	1	
Palo Alto, CA	1	
Amer. Hosp. Suppl. Corp., McGaw Park, IL		1
Antwerp Univ., Wilrijk, Belgium		1
Atom. Energy Res. Establ., Harwell, UK		1
Austr. Atom. Energy Commiss. Res. Establ., Lucas Heights, Australia		1
Austr. Natl. Univ., Canberra, Australia		1
Brigham Young Univ., Provo, UT		1
Brookhaven Natl. Lab., Upton, NY		1
City of Hope Res. Inst., Duarte, CA		1
CNRS, Thiais, France		1
Coll. France, Paris		1
Colorado State Univ., Fort Collins, CO		1
Columbia Univ., New York, NY		1
Eastman Kodak Co., Rochester, NY		1
Exxon Res. Eng. Co., Linden, NJ		1
Ford Motor Co., Dearborn, MI		1
Fraunhofer Inst. Non-destruct. Test Meth., Saarbrucken, FRG		1
Free Univ. Berlin, FRG		1
Griffith Univ., Nathan, Australia		1
Hamburg Univ., FRG		1
H.C. Orsted Inst., Copenhagen, Denmark		1
Hewlett-Packard Corp., Avondale, PA		1
Hoffmann-La Roche Inc., Nutley, NJ		1
IBM Res. Lab., San Jose, CA		1
Indiana Univ., Bloomington, IN		1
Jet Propulsion Lab., Pasadena, CA		1
Kantonales Lab., Zurich, Switzerland		1
Kratos Ltd., Manchester, UK		1
McDonnell Douglas Corp., St. Louis, MO		1
Northwestern Univ., Evanston, IL		1
Notre Dame de la Paix Univ. Fac., Namur, Belgium		1
Pennsylvania State Univ., Univ. Park, PA		1
Princeton Univ., NJ		1
Queen's Univ., Kingston, Ontario, Canada		1
Roy. Inst. Great Brit., London, UK		1
Rutgers Univ., Piscataway, NJ		1
Saar Univ., Saarbrucken, FRG		1
Sandia Natl. Lab., Livermore, CA		1
SRI Intl., Menlo Park, CA		1
Stanford Univ., CA		1
Tech. Univ. Denmark, Lyngby, Denmark		1
Texas A&M Univ., College Station, TX		1
Tohoku Univ., Sendai, Japan		1
Univ. Basel, Switzerland		1
Univ. Birmingham, UK		1
Univ. Chicago, IL		1
Univ. Goettingen, FRG		1
Univ. Leeds, UK		1
Univ. Marburg, FRG		1
Univ. Nebraska, Lincoln, NE		1
Univ. Ottawa, Ontario, Canada		1
Univ. Oxford, UK		1
Univ. Paris VII, France		1
Univ. Pittsburgh, PA		1
Univ. Regensberg, FRG		1
Univ. Toronto, Ontario, Canada		1
Univ. Trento, Italy		1
Univ. Utrecht, The Netherlands		1
Univ. Wisconsin, Madison, WI		1
Wayne State Univ., Detroit, MI		1
Weizmann Inst. Sci., Rehovot, Israel		1
Yale Univ., New Haven, CT		1

ditional papers in our study are also core to this research front. They are by Toshiki Tanaka and Robert L. Letsinger, Chemistry Department, Northwestern University, Evanston, Illinois, and Gen-Shing Ti, Barbara L. Gaffney, and

Roger A. Jones, Department of Chemistry, Rutgers University, Piscataway, New Jersey, and discuss "Syringe method for stepwise chemical synthesis of oligonucleotides" and "Transient protection: efficient one-flask syntheses of protected deoxynucleosides," respectively.

The paper by Ito is also core to front #84-0234, "Synthesis of DNA, cDNA, and nucleotides by the phosphotriester approach and other methods." cDNA is the complementary DNA that is "synthesized *in vitro* from a messenger RNA template and used in cloning."[10] These research fronts and their papers illustrate the close relationship between chemistry and other fields, particularly biology. The chemistry/physics connection is demonstrated by the Douketis, Scoles, and colleagues paper. "Intermolecular forces via hybrid Hartree-Fock-SCF plus damped dispersion (HFD) energy calculations. An improved spheri-

Table 4: The 1983 and 1984 *SCI®/SSCI®* research fronts that include at least two of the most-cited 1982 chemistry papers as core documents. A = research-front number. B = name. C = number of 1982 most-cited chemistry papers included in the core of each research front. D = number of core documents. E = number of 1983-1984 citing documents.

A	B	C	D	E
83-0072	Techniques and applications of fast-atom bombardment in desorption and secondary ion mass spectrometry	6	38	379
83-0571	Synthesis of silyl enol ethers and other organometallic reagents for use in stereoselective aldol and Claisen reactions	2	44	460
83-0684	Methods of biosynthesis of DNA and cDNA cloning into *Escherichia coli* in the production of human insulin	3	31	425
83-1039	Synthesis, X-ray crystal structure, and reactions of stable unsymmetrically substituted diphosphines	4	14	107
83-1380	Structural assignment and other aspects of multinuclear 2-dimensional nuclear magnetic resonance spectroscopy	2	59	541
83-1623	Determination of metal ions and other ionic compounds by reversed phase high-performance liquid chromatography	2	26	152
83-3408	Characterization of the aluminum silicon distribution in zeolites using high-resolution solid-state silicon-29 and aluminum-27 nuclear magnetic resonance spectroscopy	3	16	110
84-0069	Fast-atom bombardment, field desorption, and field ionization mass spectrometric characterization of peptides and other biological molecules	4	29	307
84-0130	Density-functional methods and electronic structure of surfaces in silicon and other metals	2	50	664
84-0234	Synthesis of DNA, cDNA, and nucleotides by the phosphotriester approach and other methods	2	24	268
84-0789	Laser microprobe mass spectrometry and secondary ion mass-spectrometry studies; liquid metal and other condensed materials	2	16	120
84-0971	Preparation, mechanistic studies, and applications of polymer-modified electrodes	2	7	119
84-1066	Synthesis and reactions of diphosphene, phosphaalkene, and other phosphorus compounds with double bonds	2	18	127
84-1394	Kinetics and mechanism of quenching and electron-transfer reactions in condensed media	2	42	509
84-1712	Photochemical activation of electron transfer in ruthenium and other transition-metal complexes, viologen, and other compounds	2	15	210
84-1806	Photoelectrochemical evolution of hydrogen on colloidal and electrode-coated titanium dioxide, cadmium sulfide, and other semi-conductors	2	15	210
84-1969	Stereoselective synthesis of alcohols and other compounds from chiral carbonyl compounds	2	29	310
84-2107	Conformational assignments in heteronuclear two-dimensional nuclear magnetic resonance spectroscopy	2	26	319
84-2717	Determination of inorganic anions by high-performance liquid chromatography and other aspects of ion chromatography	2	31	225
84-2764	MNDO and other *ab initio* molecular-orbital calculations of electronic structure, vibrational force fields, and other properties of molecules	5	46	1017
84-6403	High-resolution solid-state silicon-29 and aluminum-27 nuclear magnetic resonance characterization of silicon and other zeolites	2	8	83

cal model" was written by two physicists and three chemists. According to Scoles, the authors of this paper had to appeal to the advisory board of the *Journal of Chemical Physics* in order to get the article published.[11]

ISI research-front information is summarized in Table 4, where we list the 21 research fronts that include at least two papers from the Bibliography as core documents. In this study, a total of 86 fronts are represented by 81 papers. Several fronts discuss fast-atom bombardment, nuclear magnetic resonance spectroscopy, mass spectrometry, photochemistry, and liquid chromatography. Front #83-0072, "Techniques and applications of fast-atom bombardment in desorption and secondary ion mass spectrometry," includes six papers from the Bibliography. This is about 16 percent of the 38 papers that are core to it.

Five of the 105 most-cited chemistry papers in the Bibliography are core to "MNDO and other *ab initio* molecular-orbital calculations of electronic structure, vibrational force fields, and other properties of molecules" (#84-2764). One of these papers is the second most-cited article in this study. Having received 77 citations from 1982 to 1984, this *JACS* paper by Mark S. Gordon, J. Stephen Binkley, John A. Pople, William J. Pietro, and Warren J. Hehre, Departments of Chemistry, North Dakota State University, Fargo; Carnegie-Mellon University, Pittsburgh, Pennsylvania; and the University of California, Irvine, discusses "Self-consistent molecular-orbital methods. 22. Small split-valence basis sets for second-row elements." It is also core to "*Ab initio* molecular-orbital studies including correlation of electronic structure and proton transfer in hydrides, cation radicals, and other species" (#83-2634).

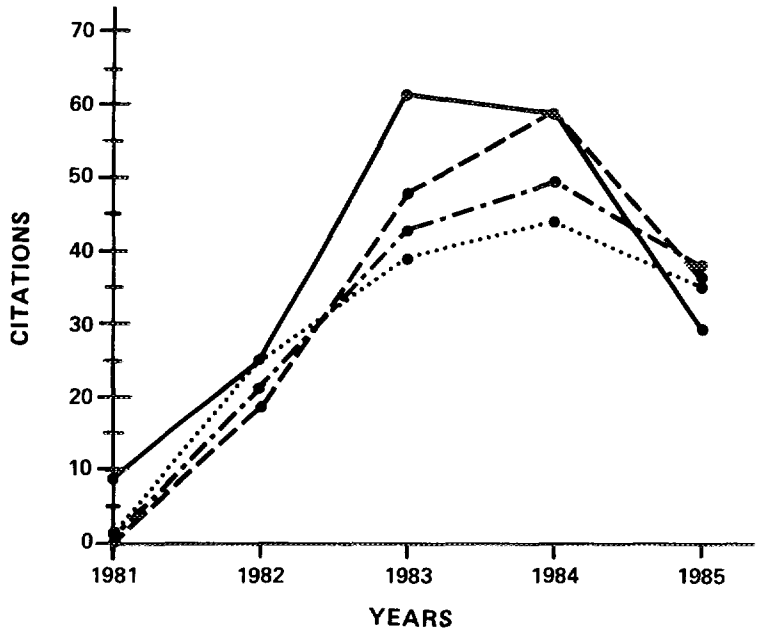
Gordon and colleagues also appear on a paper by first author Michelle M. Francl, Department of Chemistry, University of California, Irvine. This article is Part 23 in the same series on self-consistent molecular-orbital methods. It was published in the *Journal of Chemical Physics* and is also core to research front #84-2764 discussed earlier. The most recent article in this series was published in 1984.[12] And Part 21[13] was the most-cited paper in the 1980 chemistry study. This area of chemistry has become a major topic of research in the past few years. This will be even more apparent in our upcoming study of physical chemistry/chemical physics journals.

Incidentally, many papers in this study are multipart series or follow-ups to older papers. For example, the paper by Donald L. Baulch, Department of Chemistry, University of Leeds, UK, and colleagues "updates and extends a previous critical evaluation of the kinetics and photochemistry of gas phase chemical reactions of neutral species involved in middle atmosphere chemistry (10-55 km altitude)."[14] The original article was published in the *Journal of Physical and Chemical Reference Data* in 1980.[15]

A two-part paper in this study is interesting because each part appears separately in the Bibliography, but each has been cited about the same number of times. In addition, each paper was written by a completely different group of authors. "Laser microprobe mass spectrometry. 1: Basic principles and performance characteristics" by Eric Denoyer, René Van Grieken, Fred Adams, and David F.S. Natusch, Department of Chemistry, University of Antwerp, Wilrijk, Belgium, appeared in the January 1982 issue of *Analytical Chemistry* and has been cited 47 times. Part 2 of the article, "Applications to structural analysis," was published in the same journal the following month. It was written by David M. Hercules, Robert J. Day, Kesagapillai Balasanmugam, Tuan A. Dang, and Chung Ping Li, Department of Chemistry, University of Pittsburgh, Pennsylvania, and received 45 citations. As a "set," the two papers have been co-cited 23 times.

Most multipart papers are authored by the same or at least some of the same researchers. The Denoyer and Hercules papers, however, were written by two

Figure 1: Chronologic distribution of citations to the four most-cited 1981 chemistry papers: Clegg (solid line), Garrou (dotted line), Grätzel (long dash line), and Noid (dot dash line).



separate research groups because of a "coincidence." That is, the editors of *Analytical Chemistry* asked Hercules to write a paper on laser microprobe mass spectrometry, but at about the same time they received a manuscript in this area from Denoyer. That paper mainly discussed the instrumentation of mass spectrometry, while the Hercules paper focused on the application of the technique to organic molecules. The editors then asked both groups of researchers if they would be willing to publish their papers together as a two-part study.[16] As you can see, they agreed.

In these studies it is not uncommon for an author to appear on more than one paper. Six researchers on the 105 papers (A.J. Bard, C.A. Fyfe, J. Klinowski, S. Masamune, S. Ramdas, J.M. Thomas) coauthored three papers each, while 16 were on two papers. They are too numerous to list here. Two hundred seventy-one different researchers appear in the Bibliography. Almost 20 percent of these wrote their papers alone or with just one coauthor. The paper/author breakdown for all 105 articles is as follows: 2 papers have eight authors, 2 have seven; 1 has six; 15, five; 11, four; 22, three; 26, two; and 26 papers have just one author.

A two-author paper is one of two articles cited 75 times, the third highest number of citations received by papers in this study. Donald F. McMillen and David M. Golden, Department of Chemical Kinetics, SRI International, Menlo Park, California, authored the review "Hydrocarbon bond dissociation energies." "This review considers the best available values for homolytic bond dissociation energies (BDEs) of various classes of neutral compounds.... Our major emphasis is on hydrocarbons and their nitrogen, oxygen, sulfur, halogen, and silicon-containing derivations but we include limited data for inorganic molecules."[17] Not surprisingly, the *Annual Review of Physical Chemistry* published this article, which is core to research front #83-3889, "Kinetics and

mechanism of laser-induced methyne radicals with alkanes and azoalkanes."

"Attached proton test for carbon-13 NMR," the paper by Stephen L. Patt, Varian Instrument Group, Florham Park, New Jersey, and James N. Shoolery, Varian Instrument Group, Palo Alto, California, was also cited 75 times since 1982.

This concludes our analysis of the most-cited 1982 chemistry papers and completes our series on the most-cited papers from 1982. Recently we published the first two essays in the 1983 series on most-cited papers. These covered articles from the life and physical sciences.[18,19] As soon as we close out the 1985 *SCI*, we will identify the 1983 chemistry papers most cited from 1983 to 1985.

It is worth reiterating that we use three years of data for chemistry studies rather than two because experience has shown us that most well-cited papers in chemistry and the geosciences require that much, if not more, time before their impact is felt. For example, the top four papers from the 1981 study (W. Clegg,[20] P.E. Garrou,[21] M. Grätzel,[22] and D.W. Noid[23]) were each cited 96 (Clegg) or 65 times (Garrou, Grätzel, Noid) from 1981 to 1983. These counts have been almost equaled or surpassed in the two years since 1983. In 1984 Clegg's paper was cited 59 times, and in 1985 it received 29 citations. For the Garrou article these numbers are 44 and 35; for Grätzel, 59 and 36; and for the paper by Noid, 49 and 37. In Figure 1 we have illustrated these five-year citation counts. The peak year so far for all but Clegg's paper is 1984, the third year after each paper's publication. Next year it will be interesting to see the five-year citation counts for the most-cited papers in this study.

* * * * *

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

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