

# Current Comments

## The 200 "Pure" Mathematicians Most Cited in 1978 and 1979, Including a List of Most-Cited Publications for the Top 100

Number 36

September 6, 1982

In our study of the 1,000 most-cited scientists publishing from 1965 to 1978,<sup>1</sup> there were no mathematicians listed. In an earlier study of the 250 most-cited authors in *Science Citation Index*<sup>®</sup> (*SCI*<sup>®</sup>) from 1961 to 1975, only 13 were not in the life or physical sciences.<sup>2</sup> Almost all of these were statisticians—not pure mathematicians.

There are many reasons why mathematicians are "underrepresented" on these lists. These include the size of the math literature and the related fact that the average math paper contains fewer references than papers in the life and physical sciences. For example, the average biochemistry paper contains three times as many references as the average math paper.<sup>3</sup>

One does not need to perform citation analyses to confirm the truism that mathematicians make important contributions to the advance of science. And the literature of mathematics is now quite large. In recognition of this fact, we've launched a new data base covering pure and applied mathematics called *ISI/CompuMath*<sup>™</sup>.<sup>4</sup> To cover this literature efficiently, we identified the most important pure and applied math journals.<sup>3</sup> Much earlier, we identified the most-cited papers and books in mathematics.<sup>5,6</sup> But this is the first time we've done a separate study of the most-cited math authors.

We relied on the math journals listed in *SCI* in 1979 to identify the mathematicians most cited by current mathemati-

cians. Specifically, we examined those 71 journals listed under the "mathematics" subject category in the *SCI Guide and List of Source Publications*. We excluded multidisciplinary journals, such as *Doklady Akademii Nauk SSSR* and *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences Series A*, that also publish large sections on physics and astronomy, for example. We were left with a list of 64 "pure" math journals, shown in Table 1.

All references appearing in the 1978 and 1979 volumes of these journals were processed. The cited authors were ranked by frequency of combined citations in those two years. The list of cited authors was then examined for homographs—two or more individuals with the same surname and initials. Finally, we looked up citations they received from *all* journals indexed in *SCI*. This added citations from physicists, astronomers, theoretical biologists, and other scientists publishing in the journals from those fields. Table 2 shows the 100 most-cited mathematicians in 1978 and 1979 in alphabetical order. Also shown are their institutional affiliations and the number of citations from both the "core" pure math journals and all *SCI* journals.

While this method for identifying highly cited pure mathematicians in our data base isn't perfect, it seemed the best approach. For example, the distinguished French mathematician René Thom does not appear in Table 2. In 1978 and 1979, Thom's publications

**Table 1:** Math journals indexed in the 1979 *SCI*<sup>®</sup> used to identify the top 100 most-cited mathematicians, 1978 and 1979.

Acta Mathematica Academiae Scientiarum Hungaricae  
 Acta Mathematica—Djursholm  
 Advances in Mathematics  
 American Journal of Mathematics  
 American Mathematical Monthly  
 Annals of Mathematics  
 Archiv der Mathematik  
 Arkiv for Matematik  
 Bulletin de la Societe Mathematique de France  
 Bulletin of the American Mathematical Society  
 Canadian Journal of Mathematics  
 Commentarii Mathematici Helvetici  
 Communications in Algebra  
 Compositio Mathematica  
 Discrete Mathematics  
 Duke Mathematical Journal  
 Fibonacci Quarterly  
 Illinois Journal of Mathematics  
 Indiana University Mathematics Journal  
 Inventiones Mathematicae  
 Israel Journal of Mathematics  
 Journal d'Analyse Mathematique  
 Journal für die Reine und Angewandte Mathematik  
 Journal of Algebra  
 Journal of Approximation Theory  
 Journal of Combinatorial Theory Series A  
 Journal of Combinatorial Theory Series B  
 Journal of Differential Equations  
 Journal of Functional Analysis  
 Journal of Graph Theory  
 Journal of Mathematical Analysis and Applications  
 Journal of Number Theory  
 Journal of the London Mathematical Society—  
 Second Series  
 Journal of the Mathematical Society of Japan  
 Manuscripta Mathematica  
 Mathematica Scandinavica  
 Mathematical Notes  
 Mathematical Proceedings of the Cambridge Philosophical  
 Society  
 Mathematics of the USSR—Izvestia  
 Mathematics of the USSR—Sbornik  
 Mathe-matika  
 Mathematische Annalen  
 Mathematische Nachrichten  
 Mathematische Zeitschrift  
 Memoirs of the American Mathematical Society  
 Michigan Mathematical Journal  
 Monatshefte für Mathematik  
 Nagoya Mathematical Journal  
 Pacific Journal of Mathematics  
 Proceedings of the American Mathematical Society  
 Proceedings of the Edinburgh Mathematical Society  
 Proceedings of the Indian Academy of Sciences—  
 Mathematical Sciences  
 Proceedings of the Japan Academy Series A—  
 Mathematical Sciences  
 Proceedings of the Koninklijke Nederlandse Akademie  
 van Wetenschappen Series A—Mathematical Sciences  
 Proceedings of the London Mathematical Society  
 Proceedings of the Royal Society of Edinburgh  
 Section A—Mathematics  
 Quarterly Journal of Mathematics  
 Ricerche di Matematica  
 Semigroup Forum  
 Siberian Mathematical Journal  
 Studia Mathematica  
 Transactions of the American Mathematical Society  
 Topology  
 Zeitschrift für Mathematische Logik und Grundlagen  
 der Mathematik

were cited 404 times, but only 62 of these citations were from pure math journals. Non-journal items—books, proceedings, series, etc.—accounted for 264. Similarly, Andrey Kolmogorov also does not appear on our list, although he has been described as “the 20th century’s most influential Soviet mathematician.”<sup>7</sup> Kolmogorov’s publications were cited 525 times in 1978 and 1979. However, just 69 of these were from the pure math journals in Table 1.

Several mathematicians we consulted commented that many other “significant” people do not appear on the list. When we extended the study to include 200 authors, almost all of the mathematicians mentioned were included. For example, Kolmogorov is included in Table 3, which lists the next 100 mathematicians who were most cited in 1978-1979. (There are actually 103 names in Table 3 because of a tie.) But we are limited by time and space to study only the top 100 most-cited mathematicians in detail. Of course, there still might be some mathematicians perceived as significant who were not highly cited during the two years studied.

Ten authors listed in Table 2 have received the Fields Medal: L. V. Ahlfors, 1936; L. Schwartz, 1950; J.P. Serre, 1954; L. V. Hormander and J.W. Milnor, 1962; M.F. Atiyah and A. Grothendieck, 1966; D.B. Mumford, 1974; and P. Deligne and D.G. Quillen, 1978. Five more Fields Medalists appear in Table 3: K. Kodaira, 1954; S. Smale, 1966; H. Hironaka and J.G. Thompson, 1970; and C.L. Fefferman, 1978. The Fields Medal is awarded every four years by the International Mathematical Union to young mathematicians for their outstanding achievements. John Charles Fields, former mathematics professor at the University of Toronto, set up a trust fund for the medal in his will. The medal was described in *Science* as “an award comparable in many respects to the Nobel Prize in the prestige it confers.”<sup>8</sup> The

**Table 2:** The top 100 mathematicians most cited in 1978 and 1979. Asterisks indicate Fields Medal winners. A = citations from the math core journals in 1978 and 1979. B = total citations from *SCIT* journals in 1978 and 1979.

A	B		A	B		A	B	
164	202	<b>Adams, John Frank</b> University of Manchester Manchester, UK	103	650	<b>Courant, Richard</b> New York University New York, NY	284	461	<b>Hardy, Godfrey Harold</b> University of Cambridge Cambridge, UK
164	265	<b>Agmon, Szömel</b> Hebrew University Jerusalem, Israel	128	159	<b>Curtis, Charles Whitteley</b> University of Oregon Eugene, OR	161	217	<b>Harsh-Chandra</b> Institute for Advanced Study Princeton, NJ
117	171	* <b>Ahlfors, Lars Valerian</b> Harvard University Cambridge, MA	145	170	* <b>Deligne, Pierre</b> Institut des Hautes Etudes Scientifiques Bures-sur-Yvette, France	138	235	<b>Hartman, Phyllis</b> Johns Hopkins University Baltimore, MD
108	127	<b>Alfsen, Erik Magnus</b> University of Oslo Oslo, Norway	148	263	<b>Dieudonné, Jean Alexandre</b> University of Nice Nice, France	141	162	<b>Hartshorne, Robert Cope</b> University of California Berkeley, CA
140	157	<b>Arlin, Michael</b> Massachusetts Institute of Technology Cambridge, MA	346	435	<b>Dixmier, Jacques</b> University of Paris VI Paris, France	125	138	<b>Hasse, Helmut</b> University of Hamburg Hamburg, FRG
166	166	<b>Aschbacher, Michael</b> California Institute of Technology Pasadena, CA	111	137	<b>Douglas, Ronald George</b> State University of New York Stony Brook, NY	155	237	<b>Helgason, Sigurdur</b> Massachusetts Institute of Technology Cambridge, MA
252	444	* <b>Atiyah, Michael Francis</b> Oxford University Oxford, UK	324	514	<b>Dunford, Nelson</b> Yale University New Haven, CT	139	157	<b>Herstein, Israel N.</b> University of Chicago Chicago, IL
126	136	<b>Auslander, Maurice</b> Brandeis University Waltham, MA	101	824	<b>Erdelyi, Arthur</b> University of Edinburgh Edinburgh, UK	193	257	<b>Hewitt, Edwin</b> University of Washington Seattle, WA
222	255	<b>Bass, Hymen</b> Columbia University New York, NY	295	485	<b>Erdos, Paul</b> Hungarian Academy of Sciences Budapest, Hungary	154	309	<b>Hille, Einar</b> University of California La Jolla, CA
110	718	<b>Bellman, Richard Ernest</b> University of Southern California Los Angeles, CA	119	125	<b>Felt, Walter</b> Yale University New Haven, CT	119	167	<b>Hilton, Peter John</b> Case Western Reserve University Cleveland, OH
131	333	<b>Berge, Claude Jacques</b> CNRS Paris, France	161	356	<b>Friedman, Avner</b> Northwestern University Evanston, IL	115	152	<b>Hirzebruch, Friedrich</b> University of Bonn Bonn, FRG
129	338	<b>Birkhoff, Garrett</b> Harvard University Cambridge, MA	177	220	<b>Fuchs, Laszlo</b> Tulane University New Orleans, LA	334	491	* <b>Hormander, Lars</b> Volter University of Lund Lund, Sweden
297	387	<b>Borel, Armand</b> Institute for Advanced Study Princeton, NJ	207	748	<b>Gelfand, Israel</b> <b>Morsevich</b> Mathematics Institute USSR Academy of Sciences Moscow, USSR	178	189	<b>Huppert, Bertram</b> University of Mainz Mainz, FRG
517	723	<b>Bourbaki, Nicolas</b> France	109	112	<b>Glauber, George Isaac</b> University of Chicago Chicago, IL	111	123	<b>Iwasawa, Kenkichi</b> Princeton Univ. Princeton, NJ
137	167	<b>Brauer, Richard Dagobert</b> Harvard University Cambridge, MA	103	269	<b>Gokhberg, Israel</b> <b>Šudjkovich</b> Tel Aviv University Tel Aviv, Israel	261	343	<b>Jacobson, Nathan</b> Yale University New Haven, CT
115	120	<b>Bredon, Glen E.</b> Rutgers University New Brunswick, NJ	293	321	<b>Gorenstein, Daniel</b> Rutgers University New Brunswick, NJ	225	285	<b>Kaplansky, Irving</b> University of Chicago Chicago, IL
173	342	<b>Brezis, Halm</b> University of Paris VI Paris, France	126	131	<b>Grauert, Hans</b> University of Gottingen Gottingen, FRG	131	638	<b>Karlin, Samuel</b> Stanford University Stanford, CA
190	250	<b>Browder, Felix Earl</b> University of Chicago Chicago, IL	479	560	* <b>Grothendieck, Alexandre</b> University of Montpellier II Montpellier, France	343	646	<b>Kato, Tosio</b> University of California Berkeley, CA
101	140	<b>Calderon, Alberto Pedro</b> University of Chicago Chicago, IL	106	369	<b>Hale, Jack Kenneth</b> Brown University Providence, RI	144	201	<b>Kobayashi, Shoshichi</b> University of California Berkeley, CA
179	207	<b>Carlfitz, Leonard</b> Duke University Durham, NC	147	199	<b>Hall, Marshall</b> California Institute of Technology Pasadena, CA	131	263	<b>Krasnoselskii, Mark</b> <b>Aleksandrovich</b> Moscow Control Problems Institute Moscow, USSR
167	236	<b>Cartan, Henri Paul</b> University of Paris XI Paris, France	207	492	<b>Halmos, Paul Richard</b> Indiana University Bloomington, IN	136	212	<b>Kuratowski, Kazimierz</b> Warsaw University Warsaw, Poland
131	178	<b>Clifford, Alfred</b> <b>Hobltzelle</b> Tulane University New Orleans, LA	201	483	<b>Harary, Frank</b> University of Michigan Ann Arbor, MI	124	285	<b>Ladyzhenskaja, Olga</b> <b>Aleksandrovna</b> Leningrad University Leningrad, USSR

<b>A</b>	<b>B</b>	<b>A</b>	<b>B</b>	<b>A</b>	<b>B</b>
227	311	113	269	102	126
	<b>Lang, Serge</b>		<b>Polya, George</b>		<b>Spanier, Edwin Henry</b>
	Yale University		Stanford University		University of California
	New Haven, CT		Stanford, CA		Berkeley, CA
108	404	137	164	253	394
	<b>Lax, Peter David</b>		* <b>Quillen, Daniel G.</b>		<b>Stein, Elias M.</b>
	New York University		Massachusetts Institute of		Princeton University
	New York, NY		Technology		Princeton, NJ
150	167	109	370	104	112
	<b>Lindenstrauss, Joram</b>		<b>Rockafellar, Ralph Tyrrell</b>		<b>Swan, Richard Gordon</b>
	Hebrew University		University of Washington		University of Chicago
	Jerusalem, Israel		Seattle, WA		Chicago, IL
210	552	224	349	137	339
	<b>Lions, Jacques-Louis</b>		<b>Rudin, Walter</b>		<b>Titchmarsh, Edward Charles</b>
	College de France		University of Wisconsin		Oxford University
	Paris, France		Madison, WI		Oxford, UK
112	140	110	138	104	190
	<b>Lorentz, George G.</b>		<b>Sakai, Shoichiro</b>		<b>Tutte, William Thomas</b>
	University of Texas		Nihon University		University of Waterloo
	Austin, TX		Tokyo, Japan		Waterloo, Canada
137	249	111	153	145	162
	<b>Mackey, George</b>		<b>Sato, Mikio</b>		<b>Wall, Charles Terence</b>
	<b>Whitelaw</b>		Kyoto University		<b>Clegg</b>
	Harvard University		Kyoto, Japan		University of Liverpool
	Cambridge, MA		133	172	248
125	188		<b>Schaefer, Helmut H.</b>		<b>Well, Andre</b>
	<b>MacLane, Saunders</b>		University of Tubingen		Institute for Advanced Study
	University of Chicago		Tubingen, FRG		Princeton, NJ
	Chicago, IL	125	325	110	487
105	133		* <b>Schwartz, Laurent</b>		<b>Weyl, Hermann</b>
	<b>May, J. Peter</b>		Ecole Polytechnique		Institute for Advanced Study
	University of Chicago		Plaiseau, France		Princeton, NJ
	Chicago, IL	390	463	131	190
415	542		* <b>Serre, Jean-Pierre</b>		<b>Whitney, Hassler</b>
	<b>Milnor, John Willard</b>		College de France		Institute for Advanced Study
	Institute for Advanced Study		Paris, France		Princeton, NJ
	Princeton, NJ	206	228	190	214
206	228		* <b>Mumford, David Bryant</b>		<b>Zariski, Oscar</b>
	Harvard University		Princeton University		Harvard University
	Cambridge, MA	119	147	213	290
119	147		<b>Nagata, Magayoshi</b>		<b>Zygmund, Antoni</b>
	Kyoto University		Kyoto, Japan		University of Chicago
	Kyoto, Japan				Chicago, IL

**Table 3:** The next 103 mathematicians most cited in 1978 and 1979. Asterisks indicate Fields Medal winners. A = citations from the math core journals in 1978 and 1979. B = total citations from *SCP* journals in 1978 and 1979.

<b>A</b>	<b>B</b>	<b>A</b>	<b>B</b>	<b>A</b>	<b>B</b>
70	90	77	91	74	162
	<b>Amann, Herbert</b>		<b>Bousfield, Aldridge Knight</b>		<b>Crandall, Michael G.</b>
	University of Zurich		University of Illinois		University of Wisconsin
	Zurich, Switzerland		Chicago, IL		Madison, WI
68	76	83	109	87	91
	<b>Amitsur, Shmshon A.</b>		<b>Bowen, Robert E.</b>		<b>Day, Mahlon M.</b>
	Hebrew University		University of California		University of Illinois
	Jerusalem, Israel		Berkeley, CA		Urbana, IL
71	80	89	95	69	89
	<b>Andreotti, Aldo</b>		<b>Browder, William</b>		<b>Demazure, Michael</b>
	University of Strasbourg		Princeton University		Ecole Polytechnique
	Strasbourg, France		Princeton, NJ		Plaiseau, France
91	387	69	76	91	109
	<b>Arnold, Victor Igorevich</b>		<b>Carleson, Lennart Axel</b>		<b>Dickson, Leonard E.</b>
	University of Moscow		<b>Edvard</b>		University of Chicago
	Moscow, USSR		Mittag-Leffler Institute		Chicago, IL
94	123	100	111	70	92
	<b>Artin, Emil</b>		<b>Cassels, John William Scott</b>		<b>Diestel, Joseph</b>
	University of Hamburg		University of Cambridge		Kent State University
	Hamburg, FRG		Cambridge, UK		Kent, OH
74	98	87	142	69	90
	<b>Arveson, William Barnes</b>		<b>Chern, Shing-Shen</b>		<b>Dold, Albrecht</b>
	University of California		University of California		University of Heidelberg
	Berkeley, CA		Berkeley, CA		Heidelberg, FRG
83	90	93	133	100	171
	<b>Auslander, Louis</b>		<b>Chevalley, Claude</b>		<b>Eilenberg, Samuel</b>
	City University of New York		University of Paris VIII		Columbia University
	New York, NY		Paris, France		New York, NY
99	154	76	194	81	93
	<b>Bers, Lipman</b>		<b>Coddington, Earl A.</b>		<b>Everitt, William Norrie</b>
	Columbia University		University of California		University of Dundee
	New York, NY		Los Angeles, CA		Dundee, UK
93	104	78	87	74	104
	<b>Bing, R.H.</b>		<b>Conner, Pierre Euclide</b>		<b>Federer, Herbert</b>
	University of Texas		Louisiana State University		Brown University
	Austin, TX		Baton Rouge, LA		Providence, RI
72	105	83	113	100	121
	<b>Bos, Ralph P.</b>		<b>Connes, Alain</b>		* <b>Fefferman, Charles Louis</b>
	Northwestern University		Institut des Hautes Etudes		Princeton University
	Evanston, IL		Scientifiques		Princeton, NJ
93	100	78	119	91	885
	<b>Bonsall, Frank Featherstone</b>		<b>Coxeter, Harold Scott</b>		<b>Feller, Williams</b>
	University of Edinburgh		<b>MacDonald</b>		Princeton University
	Edinburgh, UK		University of Toronto		Princeton, NJ
79	118			70	76
	<b>Bort, Raoul</b>				<b>Fox, Ralph H.</b>
	Harvard University				Princeton University
	Cambridge, MA				Princeton, NJ

<b>A</b>	<b>B</b>		<b>A</b>	<b>B</b>		<b>A</b>	<b>B</b>	
86	97	<b>Frohlich, Albrecht</b> University of London London, UK	93	118	<b>Kothe, Gottfried</b> University of Frankfurt Frankfurt, FRG	97	271	<b>Segal, Irving Ezra</b> Massachusetts Institute of Technology Cambridge, MA
73	91	<b>Gabriel, Pierre</b> University of Zurich Zurich, Switzerland	92	130	<b>Krein, Mark G.</b> Institute of Physical Chemistry Odessa, USSR	81	98	<b>Sierpinski, Wacław F.</b> Warsaw University Warsaw, Poland
75	90	<b>Gamelin, Theodore W.</b> University of California Los Angeles, CA	82	88	<b>Jambek, Joachim</b> McGill University Montreal, Canada	99	287	<b>Simon, Barry Martin</b> California Institute of Technology Pasadena, CA
80	103	<b>Gillman, Leonard</b> University of Texas Austin, TX	78	98	<b>Luxemburg, Wilhelmus Anthonius Josephus</b> California Institute of Technology Pasadena, CA	98	225	<b>Smale, Stephen</b> University of California Berkeley, CA
78	79	<b>Goldschmidt, David M.</b> University of California Berkeley, CA	99	259	<b>Magnus, Wilhelm</b> Polytechnic Institute of New York New York, NY	72	77	<b>Stallings, John Robert</b> University of California Berkeley, CA
68	97	<b>Gratzer, George</b> University of Manitoba Winnipeg, Canada	92	135	<b>Michael, Ernest Arthur</b> University of Washington Seattle, WA	82	146	<b>Steinrod, Norman E.</b> Princeton University Princeton, NJ
94	109	<b>Griffiths, Phillip A.</b> Harvard University Cambridge, MA	85	102	<b>Moore, Calvin C.</b> University of California Berkeley, CA	70	70	<b>Steinberg, Robert</b> University of California Los Angeles, CA
97	115	<b>Gunsberg, Robert Clifford</b> Princeton University Princeton, NJ	78	90	<b>Morrey, Charles Bradfield</b> University of California Berkeley, CA	87	106	<b>Sullivan, Dennis</b> Institut des Hautes Etudes Scientifiques Bures-sur-Yvette, France
94	117	<b>Hall, Phillip</b> University of Cambridge Cambridge, UK	89	294	<b>Neumann, John Von</b> Institute for Advanced Study Princeton, NJ	73	73	<b>Suzuki, Michio</b> University of Illinois Urbana, IL
69	73	<b>Hayman, Walter Kurt</b> University of London London, UK	72	113	<b>Nikolskiĭ, Sergei Mikhailovich</b> Steklov Institute of Mathematics Moscow, USSR	72	232	<b>Szego, Gabor</b> Stanford University Stanford, CA
82	88	<b>Higman, Graham</b> Oxford University Oxford, UK	68	85	<b>Nussbaum, Roger David</b> Rutgers University New Brunswick, NJ	92	172	<b>Szokafalvi-Nagy, Bela</b> University of Szeged Szeged, Hungary
94	112	<b>Hironaka, Heisuke</b> Harvard University Cambridge, MA	74	124	<b>Palais, Richard Sheldon</b> Brandeis University Waltham, MA	88	127	<b>Takesaki, Masamichi</b> University of California Los Angeles, CA
76	143	<b>Hirsch, Morris William</b> University of California Berkeley, CA	74	82	<b>Pedersen, Gert Kjaergard</b> University of Copenhagen Copenhagen, Denmark	95	101	<b>Tate, John T.</b> Harvard University Cambridge, MA
87	119	<b>Hochschild, Gerhard P.</b> University of California Berkeley, CA	82	113	<b>Petre, Jaak</b> University of Lund Lund, Sweden	80	85	<b>Thompson, John G.</b> University of Cambridge Cambridge, UK
81	90	<b>Hochster, Melvin</b> University of Michigan Ann Arbor, MI	76	79	<b>Pelczyński, Aleksander</b> Polish Academy of Sciences Warsaw, Poland	74	74	<b>Timmesfeld, Franz G.</b> University of Cologne Cologne, FRG
81	118	<b>Hoffman, Kenneth</b> Hampshire College Amherst, MA	71	96	<b>Pietsch, Albrecht</b> University of Jena Jena, GDR	88	102	<b>Titi, Jacques</b> College de France Paris, France
83	100	<b>Humphreys, James E.</b> University of Massachusetts Amherst, MA	71	225	<b>Reed, Michael Charles</b> Duke University Durham, NC	83	130	<b>Treves, François</b> Rutgers University New Brunswick, NJ
76	99	<b>Kadison, Richard Vincent</b> University of Pennsylvania Philadelphia, PA	74	151	<b>Riesz, Friedrich</b> University of Budapest Budapest, Hungary	71	83	<b>Triebel, Hans</b> University of Jena Jena, GDR
96	124	<b>Kelley, John Le Roy</b> University of California Berkeley, CA	95	111	<b>Rosenthal, Haskell P.</b> University of Texas Austin, TX	80	82	<b>Waldhausen, Friedhelm</b> University of Bielefeld Bielefeld, FRG
68	74	<b>Kervaire, Michel A.</b> Geneva, Switzerland	70	109	<b>Schechter, Murray</b> Lehigh University Bethlehem, PA	80	108	<b>Warner, Garth W.</b> University of Washington Seattle, WA
90	94	<b>Knebusch, Manfred</b> University of Regensburg Regensburg, FRG	83	182	<b>Schoenberg, Isaac J.</b> University of Wisconsin Madison, WI	75	87	<b>Wolf, Joseph Albert</b> University of California Berkeley, CA
82	121	<b>Kodaira, Kunihiko</b> University of Tokyo Tokyo, Japan	72	86	<b>Segal, Graeme Bryce</b> Oxford University Oxford, UK	100	189	<b>Yosida, Kosaku</b> Gakushuin University Tokyo, Japan
69	525	<b>Kolmogorov, Andrey Nikolaevich</b> USSR Academy of Sciences Moscow, USSR						
96	169	<b>Kostant, Bertram</b> Massachusetts Institute of Technology Cambridge, MA						

**Table 4:** Institutional affiliations of the top 100 most-cited mathematicians of 1978 and 1979.

<i>Institution</i>	<i>Number of Authors</i>
University of Chicago, IL	9
Harvard University, Cambridge, MA	6
Institute for Advanced Study, Princeton, NJ	6
University of California	5
Berkeley (4)	
San Diego (1)	
Yale University, New Haven, CT	4
Massachusetts Institute of Technology, Cambridge, MA	3
University of Paris, France	3
VI, <i>Pierre et Marie Curie</i> (2)	
XI, Paris-Sud (1)	
California Institute of Technology, Pasadena	2
College de France, Paris	2
Hebrew University, Jerusalem, Israel	2
Kyoto University, Japan	2
New York University, New York	2
Oxford University, UK	2
Princeton University, NJ	2
Rutgers University, New Brunswick, NJ	2
Stanford University, CA	2
Tulane University, New Orleans, LA	2
University of Gottingen, FRG	2
University of Washington, Seattle	2
Brandeis University, Waltham, MA	1
Brown University, Providence, RI	1
Case Western Reserve University, Cleveland, OH	1
Centre National de la Recherche Scientifique, Paris, France	1
Columbia University, New York, NY	1
Duke University, Durham, NC	1
Ecole Polytechnique, Plaiseau, France	1
Hungarian Academy of Sciences, Math Research Institute, Budapest	1
Indiana University, Bloomington	1
Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France	1
Johns Hopkins University, Baltimore, MD	1
Leningrad University, USSR	1
Mathematics Institute, USSR Academy of Sciences, Moscow	1
Moscow Control Problems Institute, USSR	1
Nihon University, Tokyo, Japan	1
Northwestern University, Evanston, IL	1
State University of New York, Stony Brook	1
Tel Aviv University, Israel	1
University of Bonn, FRG	1
University of Cambridge, UK	1
University of Edinburgh, UK	1
University of Hamburg, FRG	1
University of Liverpool, UK	1
University of London, UK	1
University of Lund, Sweden	1
University of Mainz, FRG	1
University of Manchester, UK	1
University of Michigan, Ann Arbor	1
University of Minnesota, Minneapolis	1
University of Montpellier II, France	1
University of Nice, France	1
University of Oregon, Eugene	1
University of Oslo, Norway	1
University of Southern California, Los Angeles	1
University of Texas, Austin	1
University of Tubingen, FRG	1
University of Waterloo, Ontario, Canada	1
University of Wisconsin, Madison	1
Warsaw University, Poland	1

first two medals were awarded in 1936. A total of 24 mathematicians have won the medal since then. The 1982 Fields Medal winners will be announced later this year.

Table 4 lists the institutional affiliations of the top 100 most-cited pure mathematicians. Some of the mathematicians who reviewed the list observed that a few authors have retired or are deceased. Nevertheless, we feel it is important and useful to show their former institutional affiliations. Their work remains relevant to currently active mathematicians. Their institutions deserve to be acknowledged.

Interestingly, we cannot credit *any* institution with Nicolas Bourbaki's work—"he" is a secret group of mostly French mathematicians who publish under that collective pseudonym. Paul R. Halmos, Indiana University, Bloomington, claims that the membership of Bourbaki varies between ten and 20.<sup>9</sup> At various times, several of the Bourbaki members were affiliated with the University of Chicago, Illinois; Northwestern University, Evanston, Illinois; Columbia University, New York; and the University of Nancy, France. André Weil is credited with being one of the founding fathers of the group, and Jean Dieudonné is described as "Bourbaki's chief scribe almost from the beginning" of the group's publications in the mid-1930s.<sup>9</sup> Weil, Dieudonné, and Halmos appear on the list in Table 2.

The University of Chicago heads our list with nine most-cited mathematicians. The Institute for Advanced Study, Princeton, and Harvard University follow with six each. The University of California accounts for five, while Yale University has four. The University of Paris and Massachusetts Institute of Technology each have three. Twelve more institutions account for two each: California Institute of Technology; Collège de France, Paris; Hebrew University, Jerusalem; Kyoto University, Japan; New York University; Oxford Universi-

ty; Princeton University; Rutgers University; Stanford University; Tulane University; University of Göttingen, Federal Republic of Germany; and University of Washington, Seattle.

Of the 58 institutions listed, just under half, 28, are located in the US, and 62 authors are affiliated with them. Ten mathematicians are affiliated with seven French institutions, not counting Bourbaki. Seven authors did their work at six UK institutions, and the Federal Republic of Germany accounts for five institutions and six authors. The USSR has three institutions and authors. Both Israel and Japan account for two institutions with three authors each. Canada, Hungary, Norway, Poland, and Sweden each have one institution and one author.

Table 5 lists the most-cited publication as a primary author for each of the 100 math authors. Also shown are the code numbers for *ISI/CompuMath* research fronts that include the publica-

tion as a core document. Seventy-nine are books. R. Courant and D. Hilbert's *Methods of Mathematical Physics*, the oldest book on the list, was published in 1924. The four newest books on the list were published in 1973, and were authored by H. Brézis, R. G. Douglas, Hormander, and J. Lindenstrauss and L. Tzafriri. In total, two books were published in the 1920s, five in the 1930s, two in the 1940s, ten in the 1950s, 47 in the 1960s, and 13 in the 1970s.

Of the 21 papers on the list, one was published in the 1930s, three in the 1950s, 11 in the 1960s, and six in the 1970s. The two most recent papers were published in 1977—Atiyah's "Instantons and algebraic geometry" and M. Sato's "Studies on holonomic quantum fields." The oldest, "Congruent graphs, and the connectivity of graphs," by H. Whitney, was published in 1932.

As you can see, mathematicians tend to cite older literature. The so-called half-life of math research is much longer

Table 5: Most-cited publication as a primary author for each of the top 100 math authors. Publications which are in the core of an *ISI/CompuMath*<sup>™</sup> research front specialty are followed by the research front specialty number in bold.

Total SCI Citations: 1978-1979	Bibliographic Data
32	<b>Adams J F.</b> <i>Stable homotopy and generalized homology.</i> Chicago: University of Chicago Press, (1971) 1974. 305 p. <b>80-0039.</b>
67	<b>Agmon S.</b> <i>Lectures on elliptic boundary value problems.</i> Princeton, NJ: Van Nostrand, 1965. 291 p.
24	<b>Ahlfors L V.</b> <i>Lectures on quasiconformal mappings.</i> Princeton, NJ: Van Nostrand, 1966. 146 p.
48	<b>Allisen E M.</b> <i>Compact convex sets and boundary integrals.</i> New York: Springer-Verlag, 1971. 210 p.
16	<b>Artin M.</b> On isolated rational singularities of surfaces. <i>Amer. J. Math.</i> 88:129-36, 1966. <b>80-0295.</b>
19	<b>Aschbacher M &amp; Seltz G M.</b> Involutions in Chevalley groups over fields of even order. <i>Nagoya Math. J.</i> 63:1-91, 1976. <b>80-0304.</b>
48	<b>Atiyah M F.</b> Instantons and algebraic geometry. <i>Commun. Math. Phys.</i> 55:117-24, 1977. <b>80-0330.</b>
15	<b>Auslander M &amp; Goldman O.</b> The Brauer group of a commutative ring. <i>Trans. Amer. Math. Soc.</i> 97:367-409, 1960.
69	<b>Bass H.</b> <i>Algebraic K-theory.</i> New York: Springer-Verlag, (1968) 1973. 3 vols.
119	<b>Bellman R E.</b> <i>Introduction to matrix analysis.</i> New York: McGraw-Hill, (1960) 1970. 328 p.
165	<b>Berge C J.</b> <i>Graphes et hypergraphes. (Graphs and hypergraphs.)</i> Paris: Dunod, (1960) 1970. 502 p.
100	<b>Birkhoff G.</b> <i>Lattice theory.</i> Providence, RI: American Mathematical Society, (1940) 1973. 155 p.
56	<b>Borel A.</b> <i>Linear algebraic groups.</i> New York: W.A. Benjamin, 1969. 398 p.
125	<b>Bourbaki N.</b> <i>Algebre commutative (Commutative algebra.)</i> Paris: Hermann, (1961) 1972. 625 p.
9	<b>Brauer R.</b> Some applications of the theory of blocks of characters of finite groups. <i>J. Algebra</i> 1:152-67, 1964. <b>80-0858.</b>
46	<b>Bredon G E.</b> <i>Introduction to compact transformation groups.</i> New York: Academic Press, 1972. 459 p.
55	<b>Brezis H.</b> <i>Operateurs maximaux monotones et semi-groupes de contractions dans les espaces de Hilbert. (Monotonic maximal operators and contraction semi-groups in Hilbert spaces.)</i> Amsterdam: North Holland, 1973. 183 p.
12	<b>Browder F E.</b> Fixed point theory of multi-valued mappings in topological vector spaces. <i>Math. Ann.</i> 177:283-301, 1968.
19	<b>Calderon A P &amp; Zygmund A.</b> On the existence of certain singular integrals. <i>Acta Math.</i> — <i>Djursholm</i> 88:85-139, 1952.
6	<b>Carlitz L.</b> Arithmetic properties of generalized Bernoulli numbers. <i>J. Reine Angew. Math.</i> 202:174-82, 1959.

- 104 **Cartan H & Eilenberg S.** *Homological algebra*. Princeton, NJ: Princeton University Press, 1956. 390 p.  
105 **Clifford A H & Preston G B.** *The algebraic theory of semigroups*.  
Providence, RI: American Mathematical Society, (1961) 1977. 216 p. **80-1206**.
- 35 **Cohn P M.** *Universal algebra*. New York: Harper & Row, 1965. 333 p.
- 398 **Courant R & Hilbert D.** *Methoden der mathematischen physik. (Methods of mathematical physics.)* New York: Wiley, (1924) 1962. 2 vols.
- 92 **Curtis C W & Reiner I.** *Representation theory of finite groups and associative algebras*.  
New York: Wiley, (1962) 1981. 685 p.
- 17 **Deligne P, Griffiths P, Morgan J & Sullivan D.** Real homotopy theory of Kahler manifolds.  
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Paris: Gauthier-Villars, (1957) 1969. 368 p.
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Providence, RI: American Mathematical Society, 1973. 53 p.
- 469 **Dunford N & Schwartz J T.** *Linear operators*. New York: Wiley, (1958) 1971. 3 vols. **80-1539**.
- 413 **Erdelyi A, Magnus W, Oberhettinger F & Tricomi F G.** *Bateman manuscript project*.  
(Higher transcendental functions.) New York: McGraw-Hill, 1953-55. 3 vols.
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New York: Academic Press, (1964) 1967. 5 vols. **80-1867**.
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Providence, RI: American Mathematical Society, (1965) 1969. 378 p.
- 145 **Gorenstein D.** *Finite groups*. New York: Chelsea, (1967) 1980. 527 p.
- 21 **Grauert H.** Über Modifikationen und exzeptionelle analytische Mengen. (Over-modification and exceptional analytical numbers.) *Math. Ann.* 146:331-68, 1962.
- 59 **Grothendieck A.** *Elements de geometrie algebrigue. (Elements of geometric algebra.)*  
New York: Springer-Verlag, (1960) 1971. 454 p.
- 45 **Hale J K.** *Ordinary differential equations*. Melbourne, FL: Krieger, (1969) 1980. 386 p.
- 82 **Hall M.** *The theory of groups*. New York: Chelsea, (1959) 1976. 434 p.
- 92 **Halmos P R.** *Measure theory*. New York: Springer-Verlag, (1961) 1974. 305 p.
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- 146 **Hardy G H, Littlewood J E & Polya G.** *Inequalities*.  
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32	<b>Mumford D.</b> <i>Geometric invariant theory.</i> New York: Springer-Verlag, 1965. 145 p.
57	<b>Nagata M.</b> <i>Local rings.</i> Melbourne, FL: Krieger, (1962) 1975. 248 p.
50	<b>Polya G &amp; Szegö G.</b> <i>Aufgaben und Lehrsätze aus der Analysis. (Problems and theorems in analysis.)</i> New York: Springer-Verlag, (1925) 1977. 2 vols.
27	<b>Quillen D.</b> Projective modules over polynomial rings. <i>Invent. Math.</i> 36:167-71, 1976.
159	<b>Rockafellar R T.</b> <i>Convex analysis.</i> Princeton, NJ: Princeton University Press, 1970. 451 p.
91	<b>Rudin W.</b> <i>Real and complex analysis.</i> New York: McGraw-Hill, (1966) 1973. 416 p.
71	<b>Sakai S.</b> <i>C*-algebras and W*-algebras.</i> New York: Springer-Verlag, 1971. 256 p.
15	<b>Sato M, Miwa T &amp; Jimbo M.</b> Studies on holonomic quantum fields. I. <i>Proc. Jpn. Acad. A</i> 53:6-10, 1977. <b>80-2888.</b>
74	<b>Schaefer H.</b> <i>Topological vector spaces.</i> New York: Springer-Verlag, (1966) 1971. 294 p.
91	<b>Schwartz L.</b> <i>Theorie des distributions. (Theory of distributions.)</i> Paris: Hermann, (1950-51) 1966. 2 vols. <b>80-2907; 80-2908.</b>
50	<b>Serre J P.</b> <i>Corps locaux. (Local groups.)</i> Paris: Hermann, 1962. 243 p.
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92	<b>Spanier E H.</b> <i>Algebraic topology.</i> New York: McGraw-Hill, 1966. 528 p.
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18	<b>Tutte W T.</b> <i>Connectivity in graphs.</i> Toronto: University of Toronto Press, 1966. 145 p.
33	<b>Wall C T C.</b> <i>Surgery on compact manifolds.</i> New York: Academic Press, (1970) 1971. 280 p.
29	<b>Well A.</b> <i>Basic number theory.</i> New York: Springer-Verlag, (1967) 1975. 325 p.
75	<b>Weyl H.</b> <i>The classical groups.</i> Princeton, NJ: Princeton University Press, (1939) 1946. 320 p.
14	<b>Whitney H.</b> Congruent graphs and the connectivity of graphs. <i>Amer. J. Math.</i> 54:150-68, 1932.
120	<b>Zariski O &amp; Samuel P.</b> <i>Commutative algebra.</i> New York: Springer-Verlag, (1958) 1976. 2 vols. <b>80-0547.</b>
243	<b>Zygmund A.</b> <i>Trigonometrical series.</i> Cambridge, UK: Cambridge University Press, (1935) 1977. 331 p.

than other fields. It is not unusual for important mathematical works to be used decades after publication. That's one reason why our *ISI/CompuMath* files will eventually cover at least 30 years of literature. Several mathematicians noted that the significance of many mathematical discoveries is often appreciated only after a long time. Of course, this would not affect the validity of our study—its purpose is to identify the mathematicians most cited in 1978 and 1979, regardless of when their works were published. But it would be interesting to note patterns of citation to more contemporary mathematicians. For example, we could study the most-cited math authors who have published between 1965 and 1980, much as we did in the life and physical sciences.<sup>1</sup>

The 100 publications in Table 5 were written by only 132 authors. More than

three quarters (61) of the 79 books listed have one author—this includes the group of authors publishing under Bourbaki. Sixteen books have two authors, one has three, and one has four. Fourteen of the 21 papers have one author. Four papers have two authors, two have three, and one has four.

Table 6 lists the names of the *ISI/CompuMath* research fronts that include one or more of the most-cited works in Table 5 as a core document. The research front names are created by examining the most-used words or phrases in the titles of articles citing the core publications. Also shown are the mathematicians in this study whose most-cited publication appears in the research front.

The data in these tables illustrate how important it is to do these citation analyses on a field-by-field basis. The

**Table 6:** Titles of *ISI/CompuMath*<sup>™</sup> research fronts that include most-cited works by the top 100 math authors among their core documents. The names of the mathematicians in this study whose most-cited publication is included in the research front are shown in parentheses.

Research Front Number	Research Front Name
80-0039	Adams-Novikov spectral sequence, Brown-Peterson homology, Morava K-theory, and complex cobordism (Adams J F)
80-0295	Rational singularities, elliptic singularities, and normal singularities of surfaces (Artin M)
80-0304	Standard components and standard subgroups of finite simple groups (Aschbacher M)
80-0330	Yang-Mills gauge theories, Euclidean self-dual solutions, and instantons (Atiyah M F)
80-0547	Ultraproducts, power series equations, and curves with large tangent space (Zariski O)
80-0858	Blocks of characters and the structure of finite groups (Brauer R)
80-0943	P-adic L-functions, cyclotomic fields, and Iwasawa invariants (Iwasawa K)
80-1206	Semigroups: structure theorems, inverse semigroups, divisibility, lattice of ideals, representations, embedding theorems, and free semigroups (Clifford A H)
80-1539	Controllability and observability for distributed-parameter systems in Banach spaces (Dunford N)
80-1626	Representations, characters, and discrete series for semisimple Lie groups (Harish-Chandra)
80-1793	Finite groups with trivial class groups, a normal integral basis theorem, periodic projective resolutions, and locally free class groups of groups of prime power order (Swan R G)
80-1804	Injectivity, projectivity, torsion, and other properties of Abelian groups (Fuchs L)
80-1816	Spectral theory for nonlinear operators in normed spaces (Krasnoselskii M A)
80-1843	Evolution equations, Backlund transformations for a higher order Korteweg-Devries equation, and nonlinear partial differential equations solvable by inverse-scattering transforms (Lax P D)
80-1867	Localization in quantum field theory: Fourier hyperfunctions, the Bogolyubov axiomatic approach, and a relativistic invariant formulation of causality (Gelfand I M)
80-2888	Studies on holonomic quantum fields (Sato M)
80-2907	Cauchy problems, eigenspaces, and general solutions of differential equations (Schwartz L)
80-2908	Distribution theory, generalized functions, differential operators, and compact groups (Schwartz L)

most surprising result to one who is not a mathematician is the dominance of books. This is a result I might have expected in the humanities or social sciences, or even in engineering. However, the results were not so surprising to the many mathematicians who examined the list. Several commented that they would have preferred that we limit the list to journal articles. Such an approach might

have given a different perspective on current mathematical research. This will be easy to do in a future study based on even more up-to-date information.

\* \* \* \* \*

*My thanks to Dorothy Silver and Alfred Welljams-Dorof for their help in the preparation of this essay.* ©1982 ISI

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