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Journal Citation Studies. 52. The Multifaceted Structure of Crystallography Research. Part 2. A Global Perspective

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Data for crystallography journals indexed in the 1984 *Science Citation Index®* and citations from 1984 to 1988 were examined by first authors' affiliations. The top five nations in terms of productivity were the US, the Federal Republic of Germany, the USSR, the UK, and Japan. In terms of cited impact (average citations per cited article), the leaders were Finland, Sweden, Denmark, Israel, and the UK. The most-cited articles from Czechoslovakia are also presented.

This essay is based on a presentation I recently gave in Prague, Czechoslovakia, at the International Conference on Advanced Methods in X-Ray and Neutron Structure Analysis of Materials.[1] The first part appeared last week and presented a citation analysis of 11 crystallography journals indexed in the 1988 *Science Citation Index®* (*SCI®*).[2] As is usual in these analyses, we treated the journals as if they constituted a single "Macrojournal of Crystallography" and identified what it cited most frequently and, conversely, what cited it. In addition, we presented high impact articles and current research-front specialties.

In this essay we present a multinational perspective on crystallography research. The analysis identifies leading nations in terms of the number, citation, and impact of articles. It also highlights Czechoslovakia, showing that nation's highest impact articles, not only in crystallography but in all of science.

REFERENCES

1. **Garfield E.** *International crystallography research: where it is published, what it cites, and what cites it.* Speech presented to the International Conference on Advanced Methods in X-Ray and Neutron Structure Analysis of Materials, Czechoslovak Scientific and Technical Society, 21 August 1990. Prague, Czechoslovakia. 45 p.
2. ----------. Journal citation studies. 52. The multifaceted structure of crystallography research. Part 1. Core journals, high impact papers, and current research fronts. *Current Contents* (36):5-14, 3 September 1990.

International Crystallography Research: Where It Is Published, What It Cites, and What Cites It

Introduction

In characterizing the literature of crystallography and other fields, it is interesting to ask which nations are the leading producers and consumers of the discipline's research. To answer this question, a method to define the "nationality" of a paper must first be developed. The simple solution is to use the nation listed in the address given by the first author. That is, if Italy was given by the first author, the paper and its citations were credited entirely to Italy—even if coauthors were from other nations, or the first author was a French scientist on a temporary research exchange.

These potential drawbacks introduce very little noise into the system, however, since multinational collaborations make up a small but increasing fraction of the *SCI* database, typically under 5 percent. Nevertheless, certain specialties may be more seriously impacted—high-energy physics, for example, which tends to involve huge research teams.

Table 1: Field distribution of articles indexed in the 1984 *SCI*® and citations from 1984 to 1988.

Field	1984 Articles	1984-1988 Citations	Cited Articles	Five-Year Impact	Cited Impact
Life Sciences	384,781	1,712,378	211,987	4.45	8.08
Engineering	80,093	86,796	22,197	1.08	3.91
Physics	72,742	368,171	46,282	5.06	7.95
Chemistry	68,216	277,308	41,784	4.07	6.64
Geosciences	29,462	104,995	16,626	3.56	6.32
Multidisciplinary	23,128	197,736	9,679	8.55	20.43
Mathematics	17,993	26,209	8,004	1.46	3.27
Technology	11,436	22,704	5,010	1.99	4.53
Crystallography	**4,083**	**10,592**	**2,314**	**2.59**	**4.58**
TOTAL	691,934	2,806,889	363,883	4.06	7.71

Also, in order to determine the comparative impact of various nations' literature, we need to allow for an adequate time period for citation accrual. The discussion that follows is based on over 900,000 papers published in about 6,100 journals indexed in the entire 1984 ISI® database, including the *SCI*, *Social Sciences Citation Index*®, and *Arts & Humanities Citation Index*®. This allows us to examine citations over the five-year period from 1984 through 1988.

In 1984, 13 *SCI*-indexed journals were categorized under crystallography. As in Part 1 of this essay,[1] these journals were treated as if they composed a single "macrojournal" of crystallography. This macrojournal published 4,083 articles, of which 2,314 were cited 10,592 times through 1988. Dividing total citations by total articles yields a five-year impact factor of 2.59. Dividing citations by the number of *cited* articles gives a five-year *cited* impact of 4.58.

To put these data in context, Table 1 shows the fields represented in the 1984 *SCI* database, defined by journal subject categories and ranked by number of articles. Also provided are the number of citations and unique cited papers, followed by total and cited impact factors calculated over the five-year period.

The field labeled "Multidisciplinary" includes *Nature*, *Science*, and other journals publishing research in many different scientific specialties. Many of these multidisciplinary publications are highly cited, as is reflected by the five-year impact (8.55) and cited impact (20.43) factors, the highest in Table 1.

Excluding the multidisciplinary field, physics leads in terms of total impact (5.06), followed by the life sciences (4.45), chemistry (4.07), the geosciences (3.56), and crystallography (2.59).

Leading Producers of Crystallography Research

Table 2 shows how the 4,083 crystallography articles in the 1984 *SCI* were distributed by the first author's nation. Fifty-two nations were represented on these articles, and the table identifies 31 that accounted for at least 10 articles.

The US leads the world in number of crystallography articles, accounting for 728, or 17.8 percent of the total. From 1984 through 1988, 436 of these articles were cited 2,472 times. Thus, the total and cited impacts of US crystallography articles were 3.40 and 5.67, respectively.

The Federal Republic of Germany (FRG) is second in output with 502 articles (12.3 percent of total), followed by the USSR (448, 11.0 percent), the UK (330, 8.1 percent), Japan (291, 7.1 percent), France (276, 6.8 percent), and India (225, 5.5 percent).

It is interesting to note that the five leading producers account for 56.3 percent of the 1984 crystallography articles, while the top 10 account for 76.9 percent. This is another illustration of the well-known Bradford and Zipf distributions and various other statistical patterns. The literature on these subjects is too large and detailed to discuss here but has been reviewed previously.[2]

Highest Impact Nations

Sweden shows the highest impact of the 31 nations shown in Table 2. The 1984 *SCI*

indexed 57 crystallography articles with first authors from Sweden, and they were cited 283 times from 1984 through 1988, yielding a five-year impact of 4.96. Israel is second with an impact of 4.38, followed by Taiwan (4.19), the UK (4.14), and Yugoslavia (3.96).

In terms of five-year *cited* impact, the leaders are Finland (9.40), Sweden (8.58), Denmark and Israel (7.00 each), the UK (6.66), and Yugoslavia (5.84).

Leading "Consumers" of Crystallography Research

Another global perspective on crystallography research is revealed when the nations that cited this literature are identified. Fifty-four countries were represented by the first authors of 1984-1988 papers that cited the 1984 *SCI*-indexed crystallography papers. Table 3 shows 33 nations that accounted for at least 20 citations. Also shown are the number of unique articles cited.

The US again leads the list, accounting for 2,428 citations to the crystallography literature, or 22.9 percent of the total received. The UK is second with 1,187 citations (11.2 percent of total), followed by Japan (1,049, 9.9 percent), the FRG (941, 8.9 percent), France (752, 7.1 percent), and the USSR (735, 6.9 percent).

While 54 citing nations are represented, the majority of citations are concentrated within a relatively small number of nations. The top 5 account for 60.0 percent of all citations, while the top 10 citing nations account for 78.9 percent. As stated above, this is yet another illustration of general statistical patterns that have been consistently observed in various bibliographic analyses.

All western European nations, including the UK, together account for 4,325 citations, or 40.8 percent of the total. In comparison,

Table 2: Distribution of 1984 *SCI*® crystallography articles by national affiliation of first authors and citations from 1984 to 1988. Only those nations with at least 10 articles are shown.

Nations	1984 Articles	1984-1988 Citations	Cited Articles	Five-Year Impact	Cited Impact
US	728	2,472	436	3.40	5.67
FRG	502	1,183	256	2.36	4.62
USSR	448	624	230	1.39	2.71
UK	330	1,365	205	4.14	6.66
Japan	291	897	199	3.08	4.51
France	276	831	180	3.01	4.62
India	225	287	107	1.28	2.68
Italy	129	345	81	2.67	4.26
Poland	105	156	46	1.49	3.39
GDR	104	269	71	2.59	3.79
Canada	102	166	61	1.63	2.72
The Netherlands	88	290	51	3.30	5.69
Australia	72	150	37	2.08	4.05
Switzerland	70	205	38	2.93	5.39
Czechoslovakia	57	99	29	1.74	3.41
Sweden	57	283	33	4.96	8.58
Spain	50	75	25	1.50	3.00
Austria	33	54	20	1.64	2.70
Denmark	32	112	16	3.50	7.00
Israel	32	140	20	4.38	7.00
Belgium	28	45	19	1.61	2.37
Yugoslavia	28	111	19	3.96	5.84
People's Republic of China	25	43	10	1.72	4.30
Brazil	23	15	7	0.65	2.14
Bulgaria	23	65	14	2.83	4.64
Hungary	19	28	14	1.47	2.00
South Africa	19	19	8	1.00	2.38
Taiwan	16	67	13	4.19	5.15
Finland	13	47	5	3.62	9.40
Mexico	11	8	6	0.73	1.33
Egypt	10	5	2	0.50	2.50
Others (21)	137	136	56	0.99	2.43
TOTAL	4,083	10,592	2,314	2.59	4.58

Table 3: Who cites crystallography research: distribution of 1984-1988 citations to 1984 *SCI*® crystallography articles by national affiliation of first author. Only those nations with at least 20 citations are shown.

	1984 Articles	1984-1988 Citations	Cited Articles	Five-Year Impact	Cited Impact
CRYSTALLOGRAPHY	4,083	10,592	2,314	2.59	4.58
Citing Nation					
US		2,428	837		
UK		1,187	—		
(England		1,031	506)		
(Scotland		145	52)		
(Wales		8	6)		
(Northern Ireland		3	3)		
Japan		1,049	486		
FRG		941	442		
France		752	363		
USSR		735	380		
Italy		361	166		
India		324	185		
The Netherlands		315	134		
GDR		266	137		
Canada		214	155		
Australia		211	131		
Sweden		200	77		
Poland		196	125		
Switzerland		157	86		
Spain		144	85		
Israel		123	72		
Czechoslovakia		118	75		
Yugoslavia		81	42		
Taiwan		80	30		
Austria		75	38		
Bulgaria		71	51		
People's Republic of China		69	32		
Denmark		56	35		
Norway		45	20		
Belgium		41	34		
Hungary		31	27		
South Africa		31	24		
Brazil		30	20		
Finland		26	14		
Greece		25	15		
Mexico		21	12		
South Korea		20	14		
Others (21)		169	—		

Eastern Europe accounts for 777 citations, or 7.3 percent. Within Eastern Europe, the German Democratic Republic (GDR) leads with 266 citations (34.2 percent of the region's total), followed by Poland with 196 citations (25.2 percent), Czechoslovakia (118, 15.2 percent), Yugoslavia (81, 10.4 percent), Bulgaria (71, 9.1 percent), Hungary (31, 4.0 percent), and Romania (14, 1.8 percent).

Crystallography in Czechoslovak Science

Since this conference was held in Prague, it is appropriate to provide a brief overview of science and crystallography in Czechoslovakia. Table 4 shows the field distribution of the 4,486 papers from Czechoslovakia in the 1984 *SCI*, ranked by number of articles. Comparing this to Table 1, which gives similar data for the entire 1984 *SCI* file, reveals some interesting similarities and differences between Czechoslovak science and all nations represented in the *SCI*.

For example, in terms of number of publications, the life sciences account for 2,431 of Czechoslovakia's research papers, or 54.2 percent of its total. For the entire 1984 *SCI*, this field accounted for 55.6 percent. But the proportion of Czechoslovak articles in chemistry and physics combined (32.5 percent)

Table 4: Field distribution of 1984 *SCI*® articles from Czechoslovakia and citations from 1984 to 1988.

Field	1984 Articles	1984-1988 Citations	Cited Articles	Five-Year Impact	Cited Impact
Life Sciences	2,431	2,756	917	1.13	3.01
Chemistry	911	2,506	656	2.75	3.82
Physics	547	1,279	329	2.34	3.89
Engineering	221	252	78	1.14	3.23
Geosciences	138	208	67	1.51	3.10
Mathematics	114	145	56	1.27	2.58
Crystallography	**57**	**99**	**29**	**1.74**	**3.41**
Technology	24	86	16	3.58	5.38
Multidisciplinary	17	40	11	2.35	3.64
Other	26	168	45	6.46	3.73
TOTAL	4,486	7,539	2,204	1.68	3.42

is much higher than that for the *SCI* (20.4 percent). That is, Czechoslovak science seems to be more heavily concentrated in physics and chemistry than the world average as represented in the *SCI*. This has been characteristic of eastern European countries and the USSR, at least until now.[3]

The Impact of Czechoslovak Science

In terms of impact, the leaders in Czechoslovak science are technology (3.58), chemistry (2.75), physics (2.34), crystallography (1.74), and the geosciences (1.51). Technology includes three specialties—spectroscopy, microscopy, and instruments and instrumentation. Of these, spectroscopy is the clear leader, with 15 articles in 1984 that achieved a total impact of 5.13 and a cited impact of 7.70 from 1984 to 1988.

The rankings are similar for cited impact: technology (5.38), physics (3.89), chemistry (3.82), crystallography (3.41), and engineering (3.23). The data suggest that the highest impact Czechoslovak research is in the physical and chemical sciences, while the life sciences are secondary.

Except in technology and engineering, the impact of Czechoslovak science in all fields was lower than the *SCI* averages. Czechoslovak engineering articles had a five-year impact of 1.14, roughly equal to the *SCI* average of 1.08, while their cited impact of 3.23 was about 20 percent less than the *SCI* average impact of 3.91.

The impact of Czechoslovak mathematics was closest to that of the *SCI*—its impact factor of 1.27 was 87.0 percent of the 1.46 for all *SCI* mathematics articles, and its cited impact of 2.58 was 78.9 percent of the *SCI* average. The total and cited impacts of Czechoslovak crystallography were 67.2 and 74.5 percent of the *SCI* averages. Czechoslovak chemistry had an impact ratio of 67.6 percent compared to the *SCI* and 57.5 percent for cited impact, followed by physics with 46.2 percent and 48.9 percent for total and cited impacts, respectively.

In contrast, the impact of Czechoslovak life-sciences articles is well below the *SCI* average. Czechoslovak life-sciences articles achieved an impact factor of 1.13, just 25.4 percent of the *SCI* average of 4.45; their cited impact of 3.01 was 37.3 percent of the *SCI* average of 8.08.

Who Cites Czechoslovak Science

Table 5 identifies the nations and regions that cited the 1984 *SCI* Czechoslovak articles, ranked by total 1984-1988 citations. Not surprisingly, Czechoslovakia leads the list, accounting for 3,985 citations, or 52.0 percent of the total received. Virtually all nations are their own most frequent citers. For example, the US accounted for 62.9 percent of all 1984-1988 citations to its 1984 articles. However, this "self-cited rate" for the UK and other western European nations such as the FRG and France averages about 38 percent. For Eastern Europe, the self-cited rate is about 46 percent, equal to that of Japan but lower than the USSR's 67 percent.

The US is the second leading "consumer" of Czechoslovak science, accounting for 955 citations, or 12.5 percent of the total received. It is followed by the UK with 289 citations (3.8 percent), the FRG (278, 3.6 percent), the USSR (252, 3.3 percent), Japan

(241, 3.1 percent), and France (224, 2.9 percent).

Taken together, western European nations, including the UK, accounted for 1,288 citations, or 16.8 percent of the total received by Czechoslovak articles. In comparison, eastern European nations, excluding Czechoslovakia, accounted for 337 citations, or 4.4 percent. Of these 337 citations, 40.7 percent came from the GDR, followed by Poland (32.6 percent), Hungary (14.5 percent), Bulgaria and Yugoslavia (5 percent each), and Romania (2.1 percent)

High Impact Czechoslovak Crystallography Articles, 1973-1988 *SCI*

Table 6 lists 12 articles from Czechoslovakia that were published in the macromolecular journal of crystallography from 1973 to 1988 and cited at least 15 times during this time period. Full bibliographic information is provided for each article, including the institutional affiliations of all authors.

Several authors appear on more than one of the papers listed. K. Huml, J. Hašek, and D. Hlavatá, Institute of Macromolecular Chemistry, Czechoslovak Academy of Sciences, Prague, coauthored three papers. M. Glogarová and J. Pavel, Institute of Physics, Czechoslovak Academy of Sciences, were coauthors on two papers.

Of the eight institutions appearing on these papers, the Czechoslovak Academy of Sciences clearly dominates. Its various institutes were listed on eight papers, with both the Institute of Macromolecular Chemistry and the Institute of Physics listed on four papers

Table 5: Who cites Czechoslovak science: distribution of 1984-1988 citations to 1984 *SCI*® Czechoslovak articles by national affiliation of first author. Only those nations with at least 10 citations are shown.

	1984 Articles	1984-1988 Citations	Cited Articles	Five-Year Impact	Cited Impact
CZECHOSLOVAKIA	4,878	7,666	2,289	1.57	3.35
Citing Nation					
Czechoslovakia		3,985	1,766		
US		955	555		
UK		289	—		
(England		228	162)		
(Scotland		42	29)		
(Northern Ireland		10	9)		
(Wales		9	8)		
FRG		278	181		
USSR		252	185		
Japan		241	155		
France		224	153		
Canada		161	115		
GDR		137	105		
Poland		110	80		
Italy		102	77		
Spain		77	51		
The Netherlands		71	63		
India		68	53		
Australia		55	44		
Sweden		54	39		
Switzerland		50	42		
Hungary		49	38		
Belgium		45	41		
Finland		41	31		
Israel		36	29		
Denmark		34	25		
Austria		23	19		
Bulgaria		17	13		
Yugoslavia		17	15		
South Africa		16	14		
People's Republic of China		14	11		
Argentina		12	11		
Egypt		11	5		
Others (23)		242	—		

Table 6: Articles from the core crystallography journals with at least one author address in Czechoslovakia and at least 15 citations from the 1973-1988 *SCI*®. Papers are listed in alphabetic order by first author.

Cites	Bibliographic Data
28	**Březina B, Havránková M & Dušek K.** The growth of $PbHPO_4$ and $Pb_4(NO_3)_2(PO_4)_2 \cdot 2H_2O$ in gels. *J. Cryst. Growth* 34:248-52, 1976. Czech. Acad. Sci., Inst. Phys. and Inst. Macromolec. Chem., Prague, Czechoslovakia.
40	**Glogarová M, Lejček L, Pavel J, Janovec V & Fousek J.** The influence of an external electric field on the structure of chiral Sm C* liquid crystal. *Mol. Cryst. Liquid Cryst.* 91:309-25, 1983. Czech. Acad. Sci., Inst. Phys., Prague, Czechoslovakia.
15	**Hašek J, Hlavatá D & Huml K.** Complex of potassium thiocyanate and dibenzo-[*b,q*][1,4,7,10,13,16,19,22,25,28]decaoxacyclotriacontane (dibenzo-30-crown-10). *Acta Crystallogr. B—Struct. Sci.* 36:1782-5, 1980. Czech. Acad. Sci., Inst. Macromolec. Chem., Prague, Czechoslovakia.
17	**Hašek J, Hlavatá D & Huml K.** Crystal and molecular structure of a complex formed by caesium thiocyanate and 4-nitrobenzo-1,4,7,10,13,16-hexaoxacyclooctadecane (4-nitrobenzo-18-crown-6). *Acta Crystallogr. B—Struct. Sci.* 33:3372-6, 1977. Czech. Acad. Sci., Inst. Macromolec. Chem., Prague, Czechoslovakia.
17	**Hašek J, Huml K & Hlavatá D.** The structure of a complex between rubidium thiocyanate, water and dibenzo-[*b,q*][1,4,7,10,13,16,19,22,25,28]decaoxacyclotriacontane (dibenzo-30-crown-10). *Acta Crystallogr. B—Struct. Sci.* 35:330-4, 1979. Czech. Acad. Sci., Inst. Macromolec. Chem., Prague, Czechoslovakia.
16	**Klíma P, Šilhavý J, Řeřábek V, Braun I, Černý Č, Voňka P & Holub R.** A study of equilibrium reactions in the Ga—PCl_3—H_2 and Ga—$AsCl_3$—H_2 epitaxial systems. *J. Cryst. Growth* 32:279-86, 1976. Tesla-Popov Res. Inst. Radiocommun.; Inst. Chem. Technol., Dept. Phys. Chem., Prague, Czechoslovakia.
15	**Kopský V.** Tensorial covariants for the 32 crystal point groups. *Acta Crystallogr. A—Found. Crys.* 35:83-95, 1979. Czech. Acad. Sci., Inst. Phys., Prague, Czechoslovakia.
19	**Krivý I & Gruber B.** A unified algorithm for determining the reduced (Niggli) cell. *Acta Crystallogr. A—Found. Crys.* 32:297-8, 1976. Nucl. Res. Inst., Rez; Charles Univ., Fac. Math. Phys., Prague, Czechoslovakia.
15	**Kulda J.** A novel approach to dynamical neutron diffraction by a deformed crystal. *Acta Crystallogr. A—Found. Crys.* 40:120-6, 1984. Czech. Acad. Sci., Nucl. Phys. Inst., Prague, Czechoslovakia.
29	**Pavel J, Glogarová M, Demus D, Mädicke A & Pelzl G.** Chiral SmC* liquid crystals obtained by mixing of SmC and cholesteric phase. *Cryst. Res. Tech.* 18:915-21, 1983. Czech. Acad. Sci., Inst. Phys., Prague, Czechoslovakia; Martin Luther Univ., Sect. Chem., Halle-Wittenberg, GDR.
17	**Pavelčík F & Majer J.** The crystal and molecular structure of lithium [(*S,S*)-*N,N'*-ethylenediaminedisuccinato]cobaltate(III) trihydrate. *Acta Crystallogr. B—Struct. Sci.* 34:3582-5, 1978. Comenius Univ., Dept. Anal. Chem., Bratislava, Czechoslovakia.
17	**Söhnel O.** Electrolyte crystal—aqueous solution interfacial tensions from crystallization data. *J. Cryst. Growth* 57:101-8, 1982. Res. Inst. Inorg. Chem., Usti, Czechoslovakia.

each. In addition, one paper was a multinational collaboration that listed Martin Luther University, Halle-Wittenberg, GDR.

The Most-Cited Articles from Czechoslovakia, 1973-1988 *SCI*

Table 7 lists the most-cited papers from Czechoslovakia in *all* fields of science that were published from 1973 to 1988 and cited at least 100 times during this time period. Eighteen institutions appear on the 25 papers listed. The Czechoslovak Academy of Sciences dominates again, appearing on 16 papers. The academy's Institute of Experimental Biology and Genetics was listed on five papers, followed by the J. Heyrovský Institute of Physical Chemistry and Electrochemistry (four papers), Institute of Physiology (three papers), and the Institute of Organic Chemistry and Biochemistry and the Slovak Academy of Sciences, which is part of the Czechoslovak Academy of Sciences (two papers each).

Both Charles University, Prague, and Palacký University, Olomouc, appeared on two papers each. Seven papers were multinational collaborations involving researchers based at institutions in the US (three papers), Belgium (two papers), and the FRG, Norway, Spain, Switzerland, the UK, and the USSR (one each).

One author, P. Démant, Institute of Experimental Biology and Genetics, Czechoslovak Academy of Sciences, appeared on three papers. The following authors were

Table 7: The 1973-1988 *SCI*® source articles with at least one author address in Czechoslovakia and at least 100 citations from the 1973-1988 *SCI*. Papers are listed in alphabetic order by first author.

Cites	Bibliographic Data
102	**Brozman M.** Immunohistochemical analysis of formaldehyde- and trypsin- or pepsin-treated material. *Acta Histochem.* 63:251-60, 1978. Komenský Univ., Med. Fac., Bratislava, Czechoslovakia.
231	**Bubeník J, Barešová M, Viklický V, Jakoubková J, Sainerová H & Donner J.** Established cell line of urinary bladder carcinoma (T24) containing tumour-specific antigen. *Int. J. Cancer* 11:765-73, 1973. Czech. Acad. Sci., Inst. Exp. Biol. Genet.; Charles Univ., Fac. Gen. Med., Prague, Czechoslovakia.
127	**De Clercq E, Descamps J, De Somer P & Holý A.** (*S*)-9-(2,3-dihydroxypropyl) adenine: an aliphatic nucleoside analog with broad-spectrum antiviral activity. *Science* 200:563-5, 1978. Univ. Leuven, Rega Inst. Med. Res., Belgium; Czech. Acad. Sci., Inst. Org. Chem. Biochem., Prague, Czechoslovakia.
119	**Démant P.** H-2 gene complex and its role in alloimmune reactions. *Transplant. Rev.* 15:162-200, 1973. Czech. Acad. Sci., Inst. Exp. Biol. Genet., Prague, Czechoslovakia.
160	**Démant P, Capková J, Hinzová E & Vorácová B.** The role of histocompatibility-2-linked *Ss-Slp* region in the control of mouse complement. *Proc. Nat. Acad. Sci. USA* 70:863-4, 1973. Czech. Acad. Sci., Inst. Exp. Biol. Genet., Prague, Czechoslovakia.
115	**Devriese L A, Hájek V, Oeding P, Meyer S A & Schleifer K H.** *Staphylococcus hyicus* (Sompolinsky 1953) comb. nov. and *Staphylococcus hyicus* subsp. *chromogenes* subsp. nov. *Int. J. Syst. Bact.* 28:482-90, 1978. Fac. Vet. Med., Gent, Belgium; Palacký Univ., Microbiol. Inst., Olomouc, Czechoslovakia; Univ. Bergen, Gade Inst., Norway; Munich Tech. Univ., Dept. Microbiol., FRG.
142	**Farkaš V.** Biosynthesis of cell walls of fungi. *Microbiol. Rev.* 43:117-44, 1979. Slovak Acad. Sci., Dept. Biochem. Saccharides, Bratislava, Czechoslovakia.
162	**Gažo J, Bersuker I B, Garaj J, Kabešová M, Kohout J, Langfelderová H, Melník M, Serátor M & Valach F.** Plasticity of the coordination sphere of copper(II) complexes, its manifestation and causes. *Coord. Chem. Rev.* 19:253-97, 1976. Slovak Tech. Univ., Dept. Inorg. Chem., Bratislava, Czechoslovakia.
109	**Ginter E.** Cholesterol: vitamin C controls its transformation to bile acids. *Science* 179:702-4, 1973. Inst. Human Nutr. Res., Bratislava, Czechoslovakia.
113	**Gosalvez M, Blanco M, Hunter J, Miko M & Chance B.** Effects of anticancer agents on the respiration of isolated mitochondria and tumor cells. *Eur. J. Cancer Clin. Oncol.* 10:567-74, 1974. Autonomous Univ. Madrid, Fac. Med., Spain; Univ. Pennsylvania, Sch. Med., Phila., PA; Slovak Inst. Technol., Dept. Chem., Bratislava, Czechoslovakia.
249	**Gutmann E.** Neurotrophic relations. *Annu. Rev. Physiol.* 38:177-216, 1976. Czech. Acad. Sci., Inst. Physiol., Prague, Czechoslovakia.
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Conclusion

In summary, the data examined here showed that 52 nations published articles in 13 crystallography journals indexed in the *SCI* in 1984. The 5 leading producers (the US, the FRG, the USSR, the UK, and Japan) accounted for 56.3 percent, and the top 10 accounted for 76.9 percent. Furthermore, 54 nations cited these 1984 articles from 1984 through 1988. The top 5 citing nations (the US, the UK, Japan, the FRG, and France) accounted for 60.0 percent of total citations, and the top 10 accounted for 78.9 percent.

Increasingly, these and other citation data are being used for descriptive and evaluative purposes. These applications can help to determine how journals, institutions, and nations compare in terms of volume and impact of published research; what articles or research specialties have the highest and most immediate impact; and so on. We have received requests from various organizations and institutions around the world proposing citation evaluations of their nations' research. Many of these proposals understandably originate in Eastern Europe.

While we welcome such requests, we must reiterate an important point: citation data can indeed provide unique insights about published research, but they are only one of several quantitative and qualitative indicators that ought to be used to arrive at a balanced, thorough, and complete evaluation of research performance.[4,5]

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