Table 5-18. Percent distribution of the college majors of National Merit Scholars, 1966-74

Field	Percent distribution								
	1966	1967	1968	1969	1970	1971	1972	1973	1974
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Science and engineering	62.3	63.8	66.6	66.6	68.6	68.1	69.1	68.3	69.8
Engineering	8.6	10.4	10.6	9.9	12.9	9.4	8.5	9.0	11.2
Science	53.7	53.5	56.0	56.7	55.7	58.7	60.7	59.3	58.6
Physical and natural sciences	36.2	36.6	37.0	36.2	36.9	36.4	33.5	32.6	32.4
Physical sciences	14.2	13.3	11.9	11.1	12.4	10.1	8.5	8.0	8.9
Chemistry	6.0	5.4	4.1	3.7	4.6	4.0	2.9	2.6	3.1
Physics	7.6	7.0	6.9	6.4	6.2	5.0	4.2	4.4	4.4
Other physical sciences	.6	.9	.9	1.0	1.7	1.1	1.5	1.0	1.4
Life sciences	6.2	5.2	3.3	4.3	3.2	4.2	4.1	4.4	4.6
Mathematics	14.1	15.4	12.2	12.2	11.8	12.8	10.1	10.1	7.8
Unspecified physical and natural sciences	1.7	2.7	9.6	8.5	9.5	9.3	10.8	10.2	11.1
Pre-medicine	5.2	4.4	5.8	6.4	5.9	7.2	11.0	11.3	10.1
Social sciences	12.3	12.4	13.2	14.1	12.9	15.2	16.1	15.4	16.1
All other fields and undecided	37.7	36.2	33.4	33.4	31.4	31.9	30.9	31.7	30.2
Health professions	1.5	1.0	.9	1.8	1.6	1.5	2.5	2.5	1.9
All other fields	24.1	23.3	28.2	27.6	26.1	26.3	24.9	25.6	23.5
Undecided	12.1	11.8	4.3	4.0	3.7	4.1	3.5	3.6	4.8

NOTE: Detail may not add to totals because of rounding.

SOURCE: National Merit Scholarship Corporation, *National Merit Scholarship Corporation Annual Report,* annual series.

Table 5-19a. Bachelor's and first-professional degrees awarded, by field, 1960-72

Year	All fields	Science and engineering						All other fields
		Total	Physical sciences	Engineering	Mathematical sciences	Life sciences	Social sciences	
1960	394,889	120,937	16,057	37,808	11,437	24,141	31,494	273,952
1961	401,784	121,660	15,500	35,866	13,127	23,900	33,267	280,124
1962	420,485	127,469	15,894	34,735	14,610	25,200	37,030	293,016
1963	450,592	135,964	16,276	33,458	16,128	27,801	42,308	314,628
1964	502,104	153,361	17,527	35,226	18,677	31,611	50,320	348,743
1965	538,930	164,936	17,916	36,795	19,668	34,842	55,715	373,994
1966	555,613	173,471	17,186	35,815	20,182	36,964	63,424	382,142
1967	594,862	187,849	17,794	36,188	21,530	39,408	72,929	407,013
1968	671,591	212,174	19,442	37,614	24,084	43,260	87,774	459,417
1969	769,683	244,519	21,591	41,553	28,263	48,713	104,399	525,164
1970	833,322	264,122	21,551	44,772	29,109	52,129	116,561	569,200
1971	884,386	271,176	21,549	45,387	27,306	51,461	125,473	613,210
1972	937,884	281,228	20,887	46,003	27,250	53,484	133,604	656,656

SOURCE: National Center for Educational Statistics, *Earned Degrees Conferred,* annual series, and National Science Foundation, special tabulations.

Table 5-20b. Percent distribution of enrollments for advanced degrees, by field, 1960-72

Year[1]	All fields	Science and engineering						All other fields
		Total	Physical sciences	Engineering	Mathematical sciences	Life sciences	Social sciences	
1960	100	38	8	12	4	6	9	62
1961	100	38	8	12	4	6	9	62
1962	100	38	8	12	4	6	9	62
1963	100	38	8	12	4	7	9	62
1964	100	37	7	11	4	6	8	63
1965	100	37	9	11	4	7	9	63
1966	100	36	7	10	4	6	9	64
1967	100	35	6	10	4	6	9	65
1968	100	33	6	9	4	6	9	67
1969	100	32	5	9	4	6	9	68
1970	100	31	5	8	4	6	9	69
1971	100	29	5	7	3	6	9	71
1972	100	28	4	7	3	6	9	72

[1] Data as of fall terms.

NOTE: Detail may not add to totals because of rounding.

SOURCE: National Center for Educational Statistics, *Students Enrolled for Advanced Degrees*, annual series.

Table 5-21a. Master's degrees awarded, by field, 1960-72

Year	All fields	Science and engineering						All other fields
		Total	Physical sciences	Engineering	Mathematical sciences	Life sciences	Social sciences	
1960	74,497	20,012	3,387	7,159	1,765	3,751	3,950	54,485
1961	78,269	22,786	3,799	8,178	2,238	4,085	4,486	55,483
1962	84,889	25,146	3,929	8,909	2,680	4,672	4,956	59,743
1963	91,418	27,367	4,132	9,635	3,323	4,718	5,559	64,051
1964	101,122	30,271	4,567	10,827	3,603	5,357	5,917	70,851
1965	112,195	33,835	4,918	12,056	4,294	5,978	6,589	78,360
1966	140,772	38,083	4,992	13,678	5,610	6,666	7,737	102,689
1967	157,892	41,800	5,412	13,885	5,733	7,465	9,305	116,092
1968	177,150	45,425	5,508	15,188	6,081	8,315	10,333	131,725
1969	194,414	48,425	5,911	15,243	6,735	8,809	11,727	145,989
1970	209,387	49,318	5,948	15,597	7,107	8,590	12,076	160,069
1971	231,486	50,624	6,386	16,347	6,789	8,320	12,782	180,862
1972	252,774	53,567	6,307	16,802	7,186	8,914	14,358	199,207

SOURCE: National Center for Educational Statistics, *Earned Degrees Conferred*, and National Science Foundation, special tabulations.

Table 5-23a. Women science and engineering doctorate recipients, by field, 1965-74

Year	Total	Physical sciences	Engi-neering	Mathe-matical sciences	Life sciences[2]	Social sciences
1965	744	127	7	50	263	297
1966	911	132	8	48	326	397
1967	1,086	161	9	48	401	467
1968	1,295	185	12	47	483	568
1969	1,472	205	10	56	537	664
1970	1,626	243	15	77	538	753
1971	1,929	244	16	96	656	917
1972	2,101	269	21	96	680	1,035
1973	2,446	257	45	119	795	1,230
1974	2,590	260	34	115	784	1,397

Table 5-23b. Women as a percent of total science and engineering doctorate recipients, by field, 1965-74

Year	Total	Physical sciences	Engi-neering	Mathe-matical sciences	Life sciences[2]	Social sciences
1965	7	4	(1)	7	10	13
1966	8	4	(1)	6	12	15
1967	8	5	(1)	6	14	15
1968	9	5	(1)	5	14	17
1969	9	5	(1)	5	14	17
1970	9	6	(1)	6	13	17
1971	10	5	1	8	15	18
1972	11	6	1	7	15	19
1973	13	6	1	10	17	21
1974	14	7	1	10	18	24

[1] Less than 0.5 percent.
[2] Includes environmental sciences.

SOURCE: National Academy of Sciences, *Doctorate Recipients from U.S. Universities*, annual series.

Table 5-24. Minority representation among scientists and engineers, by field, 1972

	Total scientists and engineers (thousands)	Minorities as percent of total			
		All minorities	Black	Oriental	Other non-white
Total	1,336.5	4.0	1.2	2.4	0.4
Engineers	840.3	3.4	.8	2.3	.3
Mathematical scientists	31.1	8.3	4.5	3.2	.6
Computer scientists	112.1	3.5	1.5	1.5	.5
Life scientists	77.2	5.5	1.7	2.5	1.3
Physical scientists	179.8	5.8	1.7	3.8	.3
Social scientists and psychologists	95.9	4.3	2.5	1.5	.3

NOTE: Detail may not add to totals because of rounding.

SOURCE: National Science Foundation, special tabulations.

SUPPLEMENTARY COMMENTS

Dr. Saunders Mac Lane has contributed the following technical comments on the validity of the sampling procedures underlying some of the material in Chapter One. While some of the questions have been dealt with in the text itself, the National Science Board believes they should be presented in their entirety here and expresses its appreciation to Dr. Mac Lane for his observations.

There are real uncertainties and difficulties in interpreting one of the figures and one of the tables in Chapter 1.

Figure 1-7, on page 14, gives the percent distribution of scientific literature by selected field for each of six countries. As the accompanying text indicates, it is hoped that these results will indicate approximately the way in which these countries differ in their emphasis on various fields of scientific research. However, this interpretation depends on whether the data are representative. The data came from a count of articles, notes, and reviews in a sample of 2,121 scientific journals. This sample is essentially the list of journals currently used by the *Science Citation Index* and chosen from approximately 26,000 science and technology journals currently published in the world. Clearly the distribution of this data depends on the choice of the sample. If in a given country the sample over-represents journals in one science, say chemistry, then the percentage over-represents the emphasis of that country on chemistry. At present unfortunately no real evidence is available as to whether the sample is representative. There is even evidence that the sample is not representative as of certain fields. One such is mathematics (not represented in Figure 1-7). The 2,121 journals include 122 journals in mathematics. Among them at least 31 are published in the United States and only seven in Russia. This is an unbalanced representation because this same report in table 1-6 indicates correctly that the U.S. and the U.S.S.R. each publish about 30 percent of the total world literature in mathematics. Hence any percent emphasis of U.S.S.R. on mathematics calculated from these data would be wrong. This same difficulty may well occur in other fields.

Page 13 gives a small table of the CITATION INDICES of selected scientific literature by selected fields. This citation index is a ratio calculated from the same 2,121 journals; the percentage of all citations in the field which are citations of the publications of the country in question, is divided by the percentage of articles in the field published by that country. These citation indices produce a rank order of the six countries in each of the six fields of science. In five of these six fields, the U.S. ranks first and the U.S.S.R. ranks last, while in four of these six fields France ranks next to last.

Before interpreting these rankings one should recognize the limitations of this calculation. In the first place, it depends on the representative character of the sample of journals used; the indications above are that this sample may not be representative. Secondly, it depends on citations and citations in turn depend on the availability of the literature to cite. It is evidently much easier to cite a paper written in your own language and present in your own university or city library. This fact, plus the general use of the English language, may have a lot to do with the ranking of Russia, since many Russian journals are not extensively distributed, many Western scientists can't read Russian, and many Russians may not see Western journals.

I have not been able to quantify these effects. However, table 1-7b in the appendix does indicate a self-citation index (e.g., Russian papers cited in other Russian papers). In each of six fields of science Russia has by far the highest self-citation index, while in chemistry it is outranked only by West Germany and in engineering only by France. These indices do suggest one possible effect upon citation rates.

Citation rates also depend on the scientific habits of the country in question. For example, French science in several fields is remarkable because there are relatively few scientists, including many of exceptional quality and insight; such a small-scale, high quality effort would be swamped in a citation index. Moreover, much of French scientific publication appears in the *Comptes Rendus* of the French Academy of Sciences. Notes published there are limited to four pages. This results in many scientific papers, each with little room for citations. Such a publication habit, to say nothing of the centralization of French science in Paris, means that the citation indices may not properly represent the balance or quality of French science.

Saunders Mac Lane, Member
National Science Board

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Table 5-21b. Percent distribution of all master's degrees, by field, 1960-72

Year	All fields	Science and engineering						All other fields
		Total	Physical sciences	Engineering	Mathematical sciences	Life sciences	Social sciences	
1960	100	27	5	10	2	5	5	73
1961	100	29	5	10	3	5	6	71
1962	100	30	5	11	3	6	6	70
1963	100	30	5	11	4	5	6	70
1964	100	30	5	11	4	5	6	70
1965	100	30	4	11	4	5	6	70
1966	100	27	4	10	4	5	6	73
1967	100	26	3	9	4	5	6	74
1968	100	26	3	9	3	5	6	74
1969	100	25	3	8	4	5	6	75
1970	100	24	3	7	3	4	6	76
1971	100	22	3	7	3	4	6	78
1972	100	21	3	7	3	4	6	79

NOTE: Detail may not add to totals because of rounding.

SOURCE: National Center for Educational Statistics, *Earned Degrees Conferred,* and National Science Foundation, special tabulations.

Table 5-22. Doctoral degrees awarded, 1965-74

Year	All fields	Science and engineering						All other fields
		Total	Physical sciences	Engineering	Mathematical sciences	Life sciences	Social sciences	
1965	16,340	10,477	2,865	2,073	685	2,539	2,315	5,863
1966	17,953	11,456	3,058	2,299	769	2,712	2,618	6,497
1967	20,384	12,982	3,502	2,603	830	2,967	3,080	7,402
1968	22,916	14,411	3,667	2,847	970	3,501	3,426	8,505
1969	25,724	15,949	3,910	3,249	1,064	3,796	3,930	9,775
1970	29,475	17,731	4,400	3,432	1,222	4,163	4,514	11,744
1971	31,772	18,880	4,494	3,495	1,236	4,533	5,122	12,892
1972	33,001	18,940	4,226	3,475	1,281	4,505	5,453	14,061
1973	33,727	18,948	4,016	3,338	1,222	4,574	5,798	14,779
1974	33,000	18,316	3,696	3,144	1,196	4,407	5,873	14,684

SOURCE: National Academy of Sciences, *Doctorate Recipients from U.S. Universities,* annual series.

Table 5-19b. Percent distribution of all bachelor's and first-professional degrees, by field, 1960-72

Year	All fields	Science and engineering						All other fields
		Total	Physical sciences	Engineering	Mathematical sciences	Life sciences	Social sciences	
1960	100	31	4	10	3	6	8	69
1961	100	30	4	9	3	6	8	70
1962	100	30	4	8	4	6	9	70
1963	100	30	4	7	4	6	9	70
1964	100	31	4	7	4	6	10	69
1965	100	31	3	7	4	7	10	69
1966	100	31	3	6	4	7	11	69
1967	100	32	3	6	4	7	12	68
1968	100	32	3	6	4	6	13	68
1969	100	32	3	5	4	6	14	68
1970	100	32	3	5	4	6	14	68
1971	100	31	2	5	3	6	14	69
1972	100	30	2	5	3	6	14	70

NOTE: Detail may not add to totals because of rounding.

SOURCE: National Center for Educational Statistics, *Earned Degrees Conferred,* annual series, and National Science Foundation, special tabulations.

Table 5-20a. Enrollment for advanced degrees, by field, 1960-72

Year[1]	All fields	Science and engineering						All other fields
		Total	Physical sciences	Engineering	Mathematical sciences	Life sciences	Social sciences	
1960	314,349	120,638	25,707	36,636	11,770	19,715	26,810	193,711
1961	338,981	128,794	26,553	39,367	12,671	21,446	28,757	210,187
1962	373,845	142,433	28,591	43,850	14,121	23,953	31,918	231,412
1963	413,366	158,051	30,959	48,917	15,974	26,888	35,313	255,315
1964	477,535	178,123	34,061	54,318	18,805	30,787	40,152	299,412
1965	535,332	195,346	36,506	57,516	21,014	34,749	45,561	339,986
1966	583,000	207,049	37,950	58,338	23,150	37,007	50,604	375,951
1967	649,697	224,468	40,477	62,633	25,066	39,954	56,368	425,229
1968	703,745	234,661	40,937	63,662	26,840	41,676	61,546	469,084
1969	756,865	243,715	39,885	65,048	29,175	44,203	65,404	513,150
1970	816,207	252,159	40,113	64,788	30,608	46,260	70,390	564,048
1971	836,294	246,100	38,928	59,321	28,847	47,662	71,342	590,194
1972	858,580	242,988	36,047	55,847	28,064	49,118	73,912	615,592

SOURCE: National Center for Educational Statistics, *Students Enrolled for Advanced Degrees,* annual series.