The Support of Research in the Bio-Sciences for the Fiscal Years 1952 and 1953

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THIS report presents a summary of certain funds awarded for research in the bio-sciences during two fiscal years, 1952 and 1953, each of which begins on July 1 and ends on June 30. It follows and supplements "The support of research in medical and allied fields for the period 1946 through 1951" (*1*) and is designed for comparison with that study.

tion, Public Health Service, and Veterans Administration) and the funds awarded by the national offices of major fund-raising organizations and by the private foundations that make awards on a nation-wide scale. Our records for these agencies are essentially complete, and the funds, therefore, represent those available for investigative research from national sources, exclusive of industry.

TABLE 1. Support of investigative research in the bio-sciences, fiscal years 1950, 1952, and 1953.

	1950			1952			1953		
	No. of grants	Amounts	Percentage of amount	No. of grants	Amounts	Percentage of amount	No. of grants	Amounts	Percentage of amount
Total	3317	33,000,870	100	4269	48,186,562	100	4933	55,995,286	100
Government	2052	21,320,493	65	3022	34,533,220	72	3558	40,234,918	72
Nongovernment	1265	11,680,377	35	1247	13,653,342	28	1375	15,760,368	28

TABLE 2. Percentage increases in grants and amounts.

	1952 increase over 1950		1953 increase over 1950	
	Grants	Amounts	Grants	Amounts
Total	29	46	49	70
Government	41	62	73	89
Nongovernment	− 1	17	9	35

It should be clearly understood that the funds used in this report do not represent the total cost of research in the bio-sciences. They are the funds awarded on a project basis by the agencies listed in the foregoing paragraph, and they do not include the cost of this research to the institutions in which the work is conducted. No funds for the care and rehabilitation of patients (for which money from fund-raising organizations is often allocated), for fellowships, for control programs, or for construction programs are included. Thus, this report is based upon a discrete body of data comprised of a definite number of grants in known amounts awarded during each fiscal year.

TABLE 3. Annual percentage changes in grants and amounts awarded, all sources, 1950–1953.

	1950		1951		1952		1953	
	Grants	Amounts	Grants	Amounts	Grants	Amounts	Grants	Amounts
All agencies	18	0	17	26	10	16	16	16
Government	42	10	26	37	17	18	18	17
Nongovernment	− 7	−15	4	5	− 5	11	10	15

The data upon which this report is based are the funds awarded for nonsecurity classified grant (*2*) and contract research in the bio-sciences by seven government agencies (Atomic Energy Commission, Department of the Air Force, Department of the Army, Department of the Navy, National Science Founda-

Other types of extramural support of research have been excluded. Considerable thought has been given to the wisdom of gathering concise information from purely local foundations. The diversity of such organizations and the lack of established granting policies with regard to type of research supported or the probable duration of interest in any research field

* The views and opinions expressed here are those of the authors and not necessarily those of the members of the Governing Board of the BSIE or the agencies they represent.

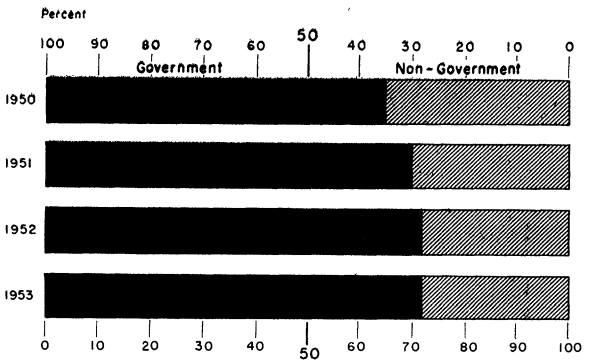

Fig. 1. Percentages of funds for research in the biosciences from government and nongovernment sources.

have reasoned against the inclusion of these data. Most local foundations appear to be mechanisms for family or individual giving with primary interest in community services and welfare. Additional local support of research reaches universities in the form of special contributions or bequests, and no effective procedure for obtaining current information on funds of this character can be established.

In this report, the year 1950 has been selected as a base for comparison, because the published figures for that year are the most complete, whereas those for 1951 represented only a part of the year. Although the 1951 figures have since been revised to reflect the total year, it is believed that the changes in 1952 and 1953 are better illustrated by a comparison with 1950. In the instances, however, where reference is made to 1951 amounts, the figures used are the revised or complete ones.

Table 1 carries the number of grants and amounts awarded in 1950, 1952, and 1953. It again discloses that increased funds from government sources have not diminished contributions from nongovernment agencies, despite the redirected programs of some private foundations.

Tables 2 and 3 illustrate, respectively, the percent-

TABLE 4. Number of states receiving grants.*

Fiscal year	Total states supported	Source of support		
		Government	Nongovernment	Both
1952	49	47	45	43
1953	48	48	42	42

* District of Columbia regarded as a state.

TABLE 5. State distribution of amounts from all sources.

Thousands of dollars	1950		1952		1953	
	State	Percentage	State	Percentage	State	Percentage
10,000–11,000					New York	20
7,500–10,000			New York	20		
5,000– 7,500	New York	19	Massachusetts	14	Massachusetts	13
2,500– 5,000	Massachusetts	10	California	8	California	9
	Illinois	9	Pennsylvania	7	Pennsylvania	7
	California	8	Illinois	7	Illinois	6
1,000– 2,500	Pennsylvania	7	Ohio	5	Ohio	4
	District of Columbia	5	Maryland	3	Michigan	3
	Maryland	4	Michigan	3	Maryland	3
	Ohio	4	Connecticut	3	Connecticut	3
			Minnesota	2	Minnesota	3
					North Carolina	2
					Missouri	2
					District of Columbia	2
750– 1,000	Michigan	3	District of Columbia	2	Louisiana	2
	Minnesota	3	Missouri	2	Texas	*
	Connecticut	2	North Carolina	2	Indiana	*
	Missouri	2			Utah	*
					Wisconsin	*
500– 750	North Carolina	2	Washington	2	Washington	*
	Louisiana	2	Texas	2	Kansas	*
	Tennessee	2	Louisiana	*	Tennessee	*
			Utah	*	Virginia	*
			Indiana	*	Colorado	*
			Wisconsin	*		
			Virginia	*		
			Tennessee	*		

* Less than 2 percent.

TABLE 5.—(*Continued*)

Thousands of dollars	1950		1952		1953	
	State	Percentage	State	Percentage	State	Percentage
250– 500	Wisconsin	*	Colorado	*	Georgia	*
	Texas	*	Kansas	*	Florida	*
	Utah	*	Georgia	*	Maine	*
	Washington	*	Iowa	*	Iowa	*
	Colorado	*	Alabama	*	New Jersey	*
	Kansas	*	Maine	*	Oregon	*
	Virginia	*	New Jersey	*	Alabama	*
			Oregon	*		
100– 250	Indiana	*	Oklahoma	*	Oklahoma	*
	Georgia	*	Florida	*	Kentucky	*
	Maine	*	Kentucky	*	Rhode Island	*
	Iowa	*	New Mexico	*	South Carolina	*
	New Jersey	*	Nebraska	*	Nebraska	*
	Florida	*	Rhode Island	*		
	Oregon	*				
	Alabama	*				
	Oklahoma	*				
50– 100	New Mexico	*	Arkansas	*	Delaware	*
	Kentucky	*	South Carolina	*	Arkansas	*
	Vermont	*	Vermont	*	Vermont	*
	Nebraska	*	Montana	*	New Mexico	*
25– 50	Rhode Island	*	North Dakota	*	Montana	*
	Montana	*	Mississippi	*	New Hampshire	*
	South Carolina	*	South Dakota	*	South Dakota	*
	Arkansas	*			Mississippi	*
					Idaho	*
10– 25	South Dakota	*	Delaware	*	North Dakota	*
	Mississippi	*	Idaho	*	Arizona	*
	Arizona	*	West Virginia	*	West Virginia	*
	West Virginia	*	Arizona	*		
	North Dakota	*	New Hampshire	*		
	Wyoming	*				
Less than 10	Idaho	*	Wyoming	*	Wyoming	*
	New Hampshire	*	Nevada	*		
No funds	Delaware				Nevada	
	Nevada					

* Less than 2 percent.

age increases in amounts over 1950 and the annual percentage increases during a 4-year period. When these increases are calculated for the longer period, the proportional increase from government sources greatly exceeds that from nongovernment sources. When the annual changes are examined, however, it is evident that the percentage increases from nongovernment sources are growing and are approaching, in percentage, the government figure, although the disparity in amount still is great. It is of interest that the greatest percentage increase in government funds occurred in 1951, whereas the highest nongovernment percentage rise was in 1953. Nevertheless, government sources are still accounting for 72 percent of this type of research support (Fig. 1).

The awards within the United States amounted to $46,710,135 (97 percent of the total) in 1952 and to $53,972,797 (96 percent) in 1953. Nongovernment agencies contributed more generously than government ones in both years to research in foreign countries.

Within the United States (for purposes of this report, the District of Columbia is considered a state), the number of states supported and the distribution of funds among the states are essentially the same as in 1950. Tables 4 and 5 illustrate the distribution of awards among the states. In all 3 years, five states—New York, Massachusetts, Illinois, California, and Pennsylvania—account for more than 50 percent of the total funds. When the awards to the District of Columbia, Maryland, Ohio, Michigan, Minnesota, Connecticut, Missouri, and North Carolina are added, more than 75 percent of the total funds are accounted for.

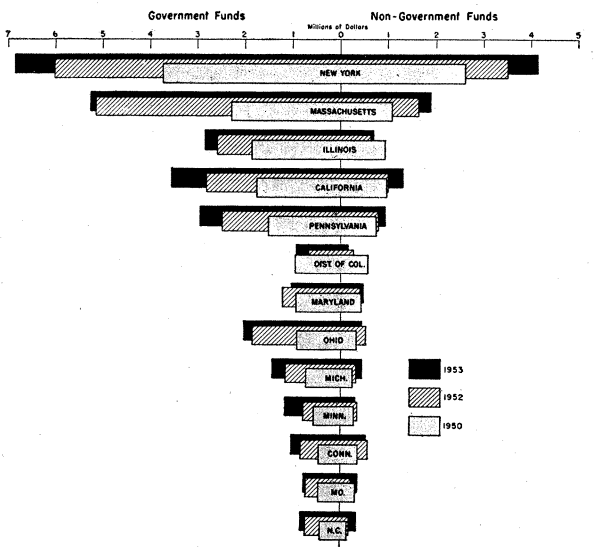

Fig. 2. Distribution of funds to 13 states receiving annually more than 75 percent of the total.

Figure 2 presents the amounts received by these 13 states in each of the 3 years. It indicates that the increase in nongovernment funds in the last 2 years has been largely absorbed by New York, Massachusetts, and California, whereas the government increase is more widely spread.

The distribution of grants by size (Table 6) has changed little since 1950. The trend toward fewer grants below $5000 and more between $5000 and $10,000, which was well established by 1950, has continued and is emphasized still further in 1952 and 1953. There is little change in the percentage distribution of grants of other sizes, and the percentage of all grants in amounts of $20,000 and over remains approximately 11 percent.

An interesting facet of this study is revealed in the number of investigators associated with research supported by extramural funds. The material available in the Exchange does not yet warrant an exhaustive analysis, which will be possible after a longer interval, but certain figures are well worth presenting at this time.

TABLE 6. Percentage distribution of grants by size.

Thousands of dollars	All grants		Government grants		Nongovernment grants	
	1952	1953	1952	1953	1952	1953
0– 4.9	30	28	25	24	42	36
5– 9.9	35	37	36	38	33	36
10–19.9	24	24	27	27	15	16
20–29.9	6	6	7	6	4	6
30–39.9	2	2	2	3	2	2
40–49.9	1	1	1	1	1	1
50–above	2	2	2	1	3	3

From 1946 through 1953, the names of 12,569 professional persons have been registered with the Exchange. This figure represents *different individuals* and is not a summation of the number of investigators registered in each successive year. Of these individuals, 5398 were designated principal investigators and the remaining 7171 were associated with the research in other professional capacities.

Turning to the number of investigators supported each year, the annual increase from the base year 1950 is illustrated in Table 7, which shows in 1953

TABLE 7. Distribution of awards among investigators.

All investigators	1950		1951		1952		1953	
	No.	%	No.	%	No.	%	No.	%
Total	3053	100	5496	100	6629	100	7693	100
Registered first time	1431	47	3136	57	3144	47	2791	36
Registered in 1 year only	390	13	1216	22	1332	20		

Principal investigators	1950		1951		1952		1953	
	No.	%	No.	%	No.	%	No.	%
Total	2271	100	2555	100	3003	100	3310	100
Registered first time	897	39	758	30	896	30	641	19
Registered in 1 year only	220	10	195	8	310	10		

Other professional personnel	1950		1951		1952		1953	
	No.	%	No.	%	No.	%	No.	%
Total	782	100	2941	100	3626	100	4383	100
Registered first time	534	68	2378	81	2248	62	2150	49
Registered in 1 year only	170	22	1021	35	1022	28		

an increase of 4640 investigators over 1950. The increase in principal investigators during this same period was more than 1000.

The number of investigators whose names appear for the first time in each of these 4 years clearly emphasizes the wide distribution of awards among scientists. The names of from 600 to 800 new principal investigators appear each year along with an even greater number of associated investigators in every year except 1950.

Our earlier findings established the continuity of support of projects; our present findings indicate the continuity of support of men: approximately 75 percent of all investigators and 90 percent of all principal investigators have received 2 or more years of support. The following brief tabulation shows the duration of support of the 897 principal investigators who worked under extramural funds for the first time in 1950.

	No. of principal investigators	*Percentage*
Total	897	100
1 year	220	25
2 years	218	24
3 years	196	22
4 years	263	29

One wonders what has happened to 1522 investigators (1196 principal, 326 other) who were supported at some time up to and including 1950 but whose names have not been associated with extramurally supported research in 1951, 1952, or 1953. Death and retirement for age account for a share, but how many have been otherwise diverted from research or have not measured up to the standards of granting agencies is in the realm of speculation. Referring again to Table 7, 13 to 22 percent of all investigators and 8 to 10 percent of the principal investigators appear to receive support for 1 year only.

The subject analysis that follows is based entirely on the multiple subject category method of indexing. After long consideration and continued trial, the division of total funds into single subject categories was discarded in the belief that the number of arbitrary decisions involved negates the value of results that could be achieved with equal accuracy by far less refined techniques than the scrutiny of individual projects. The distribution of funds among disciplines was likewise rejected, because there are no criterions for determining boundaries of disciplines and no sound method of distinguishing between them.

To understand the multiple subject category method of indexing, it must be recognized that every major category or topic of the first order is simply the title of an individual index, which is independent of all other major categories and is complete for the whole body of the material under consideration. In other words, each of the approximately 100 major categories of the index represents a different aspect and

TABLE 8. Amounts awarded major multiple subject categories.

Subject category	1950		1952		1953	
	No. of grants	Amounts	No. of grants	Amounts	No. of grants	Amounts
Cancer	631	6,914,144	770	8,309,327	936	10,397,088
Government	332	3,377,875	413	4,369,981	537	5,800,075
Nongovernment	299	3,536,269	357	3,939,346	399	4,597,013
Infectious diseases	412	5,672,626	512	8,137,035	574	8,540,463
Government	297	3,373,845	386	4,730,744	438	5,654,239
Nongovernment	115	2,298,781	126	3,406,291	136	2,886,224
Cardiovascular system	532	5,164,825	648	6,742,892	802	8,160,359
Government	375	3,929,867	482	5,614,281	598	6,670,751
Nongovernment	157	1,234,958	166	1,128,611	204	1,489,608
Metabolism and metabolic diseases	426	3,818,337	748	7,631,177	982	10,774,049
Government	281	2,569,971	553	5,956,636	739	8,777,383
Nongovernment	145	1,248,366	195	1,674,541	243	1,996,666
Nervous system	273	3,571,999	420	6,549,718	460	6,314,655
Government	151	1,447,962	293	3,128,009	334	3,445,016
Nongovernment	122	2,124,037	127	3,421,709	126	2,869,639
Endocrine system	400	3,434,342	694	7,019,425	698	7,763,255
Government	285	2,537,556	507	5,494,575	505	5,990,631
Nongovernment	115	896,786	187	1,524,850	193	1,772,624
Psychological sciences	227	3,113,713	397	6,453,353	395	6,679,359
Government	194	2,744,604	330	5,350,343	333	5,237,854
Nongovernment	33	369,109	67	1,103,010	62	1,441,505
Musculoskeletal system	208	2,985,312	268	5,545,322	259	4,895,456
Government	89	814,015	147	2,153,426	147	2,044,042
Nongovernment	119	2,171,297	121	3,391,896	112	2,851,414
Urogenital system	259	2,110,283	432	3,827,622	453	4,052,297
Government	171	1,511,678	300	3,017,980	308	3,026,722
Nongovernment	88	598,605	132	809,642	145	1,025,575

TABLE 8.—(*Continued*)

Subject category	1950		1952		1953	
	No. of grants	Amounts	No. of grants	Amounts	No. of grants	Amounts
Deficiency diseases and nutrition	225	1,886,074	348	3,329,065	400	3,974,572
Government	126	1,266,228	216	2,412,884	269	3,008,094
Nongovernment	99	619,846	132	916,181	131	966,478
Problems of children	199	1,875,804	290	2,847,621	295	2,939,987
Government	134	1,357,930	209	2,087,427	195	2,023,110
Nongovernment	65	517,874	81	760,194	100	916,877
Digestive system	236	1,752,511	306	3,163,405	358	3,556,674
Government	186	1,515,606	250	2,819,772	295	3,117,021
Nongovernment	50	236,905	56	343,633	63	439,653
Blood	182	1,679,794	383	4,756,605	444	5,429,282
Government	118	1,282,404	309	4,187,694	356	4,854,394
Nongovernment	64	397,390	74	568,911	88	574,888
Injury and shock	120	1,471,426	257	4,273,339	297	5,059,927
Government	98	1,332,983	238	4,127,977	278	4,933,023
Nongovernment	22	138,443	19	145,362	19	126,904
Respiratory system	107	1,022,819	215	2,521,973	256	3,101,276
Government	86	871,522	175	2,164,717	199	2,535,741
Nongovernment	21	151,297	40	357,256	57	565,535
Ageing	76	981,640	104	1,129,545	127	1,403,125
Government	52	753,494	83	928,979	102	1,113,315
Nongovernment	24	228,146	21	200,566	25	289,810
Emotional and psychiatric states	78	966,283	125	1,684,760	111	1,615,727
Government	70	877,933	113	1,473,955	102	1,388,609
Nongovernment	8	88,350	12	210,805	9	227,118
Integumentary system	57	610,786	81	965,798	100	1,196,596
Government	45	554,311	69	851,873	82	978,154
Nongovernment	12	56,475	12	113,925	18	218,442
Public health	35	593,570	55	799,644	53	761,395
Government	19	404,338	36	613,011	36	539,436
Nongovernment	16	189,232	19	186,633	17	221,959
Ecology and environment	55	582,918	122	1,473,052	203	2,343,715
Government	44	524,013	107	1,378,058	191	2,223,882
Nongovernment	11	58,905	15	94,994	12	119,833
Sanitary engineering	54	559,097	68	706,707	81	1,000,896
Government	51	528,017	66	547,456	76	817,030
Nongovernment	3	31,080	2	159,251	5	183,866
Sensory organs	50	538,112	144	1,493,514	156	1,659,496
Government	45	487,468	123	1,401,947	124	1,488,390
Nongovernment	5	50,644	21	91,567	32	171,106
Venereal diseases	31	453,605	21	208,446	14	97,207
Government	29	441,405	19	204,346	13	95,407
Nongovernment	2	12,200	2	4,100	1	1,800
Stress	24	355,748	131	1,637,323	158	2,283,455
Government	16	282,929	114	1,444,380	136	2,050,782
Nongovernment	8	72,819	17	192,943	22	232,673
Allergy and anaphylaxis	46	336,661	80	818,369	81	819,964
Government	37	249,021	68	746,814	69	727,728
Nongovernment	9	87,640	12	71,555	12	92,236
Dental research	50	313,836	63	436,575	98	805,766
Government	43	283,736	55	400,821	89	760,688
Nongovernment	7	30,100	8	35,754	9	45,078
Anesthesia and analgesia	25	260,577	37	346,041	52	426,435
Government	21	245,027	33	321,805	46	378,362
Nongovernment	4	15,550	4	24,236	6	48,073
Occupational diseases	21	166,327	28	355,642	37	518,068
Government	18	137,827	24	281,655	31	412,944
Nongovernment	3	28,500	4	73,987	6	105,124
Intoxication and drug addiction	11	77,336	19	114,866	20	150,793
Government	6	47,081	10	78,832	9	98,254
Nongovernment	5	30,255	9	36,034	11	52,539

provides a survey of the whole body of material from a particular point of view. It should be clear now that the funds awarded to the major categories cannot be added, since the same problem is usually involved in several major categories. Within each major category, it is a relatively simple matter to assign a problem to a particular subcategory; consequently, a project falls only once within a major category and the funds awarded to any major category may be divided among its subcategories.

It is obvious that in a report of this type all the major categories cannot be considered. The number of these topics is continually growing in accordance with new interests of investigators and of granting agencies. Twenty-nine of the major categories have been selected for presentation. These are, with one exception, those used in the earlier report (*1*) and are those of interest to the greatest number of granting agencies. The exception is that the category "Psychological sciences" has replaced the category "Social sciences."

The increases in total funds in 1952 and 1953 over those awarded in 1950 have been reflected in 28 of the 29 categories under consideration. The "Venereal diseases" category is the only one that has had a pronounced decrease in support and by 1953 received only 21 percent of the amount it had in 1950. Table 8 shows the funds awarded each of these major categories.

Eight of the 10 most liberally supported fields in 1950 are among the 10 receiving the highest support in both 1952 and 1953. The two fields that dropped out of the top bracket are the "Urogenital system" and "Deficiency diseases and nutrition," both of which, while receiving considerable increases in 1952 and 1953, were overshadowed by the added support awarded for studies of "Blood" and of "Injury and shock."

Although research in no one of the categories "Pub-

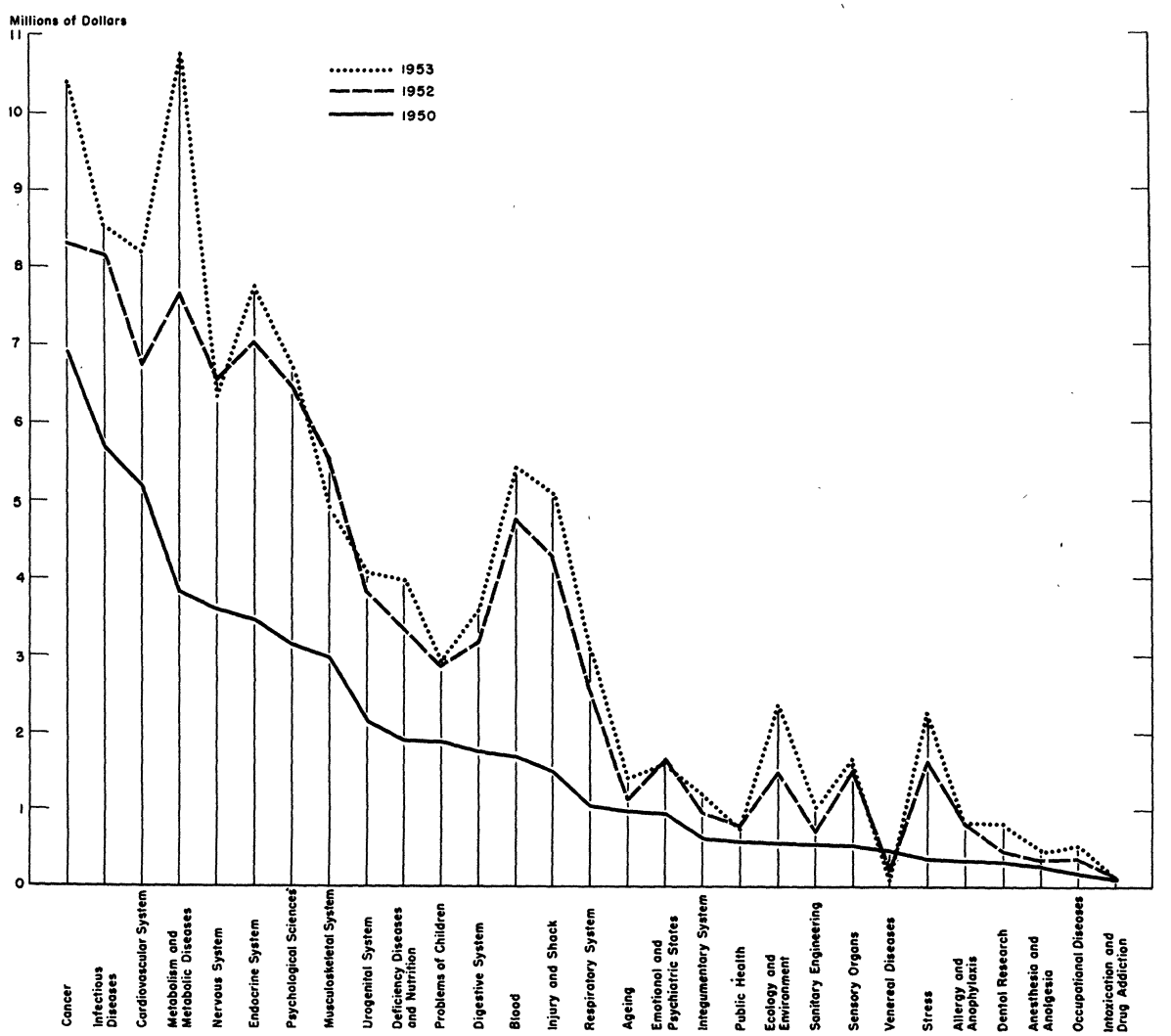

Fig. 3. Amounts awarded multiple subject categories from all sources.

TABLE 9. Percentage changes in amounts awarded major multiple subject categories, all sources.

Subject category	1952 change over 1950	1953 change over 1950	1953 change over 1952
Cancer	20	50	25
Infectious diseases	43	51	5
Cardiovascular system	31	58	21
Metabolism and metabolic diseases	100	182	41
Nervous system	83	77	− 4
Endocrine system	104	126	11
Psychological sciences	107	115	4
Musculoskeletal system	86	64	− 12
Urogenital system	81	92	6
Deficiency diseases and nutrition	77	111	19
Problems of children	52	57	3
Digestive system	81	103	12
Blood	183	223	14
Injury and shock	190	244	18
Respiratory system	147	203	23
Ageing	15	43	24
Emotional and psychiatric states	74	67	− 4
Integumentary system	58	96	24
Public health	35	28	− 5
Ecology and environment	153	302	59
Sanitary engineering	26	79	42
Sensory organs	178	208	11
Venereal diseases	− 54	− 79	− 53
Stress	360	542	40
Allergy and anaphylaxis	143	144	—
Dental research	39	157	85
Anesthesia and analgesia	33	64	23
Occupational diseases	114	212	46
Intoxication and drug addiction	49	95	31

TABLE 10. Percentage changes in amounts awarded major multiple subject categories, government sources.

Subject category	1952 change over 1950	1953 change over 1950	1953 change over 1952
Cardiovascular system	43	70	19
Cancer	29	72	33
Infectious diseases	40	68	20
Psychological sciences	95	91	− 2
Metabolism and metabolic diseases	132	242	47
Endocrine system	117	136	9
Digestive system	86	106	11
Urogenital system	100	100	—
Nervous system	116	138	10
Problems of children	54	49	− 3
Injury and shock	210	270	20
Blood	227	279	16
Deficiency diseases and nutrition	91	138	25
Emotional and psychiatric states	68	58	− 6
Respiratory system	148	191	17
Musculoskeletal system	165	151	− 5
Ageing	23	48	20
Integumentary system	54	77	15
Sanitary engineering	4	55	49
Ecology and environment	163	324	61
Sensory organs	188	205	6
Venereal diseases	− 54	− 78	− 53
Public health	52	33	− 12
Dental research	41	168	90
Stress	411	625	42
Allergy and anaphylaxis	200	192	− 3
Anesthesia and analgesia	31	54	18
Occupational diseases	104	200	47
Intoxication and drug addiction	67	109	25

TABLE 11. Percentage changes in amounts awarded major multiple subject categories, nongovernment sources.

Subject category	1952 change over 1950	1953 change over 1950	1953 over change 1952
Cancer	11	30	17
Infectious diseases	48	26	− 15
Musculoskeletal system	56	31	− 16
Nervous system	61	35	− 16
Metabolism and metabolic diseases	34	60	19
Cardiovascular system	− 9	21	32
Endocrine system	70	98	16
Deficiency diseases and nutrition	48	56	6
Urogenital system	35	71	27
Problems of children	47	77	21
Blood	43	45	1
Psychological sciences	199	291	31
Digestive system	45	86	28
Ageing	− 12	27	45
Public health	− 1	17	19
Respiratory system	136	274	58
Injury and shock	5	− 8	− 13
Emotional and psychiatric states	139	157	8
Allergy and anaphylaxis	− 18	5	29
Stress	165	220	21
Ecology and environment	61	103	26
Integumentary system	102	287	92
Sensory organs	81	238	87
Sanitary engineering	412	492	16
Intoxication and drug addiction	19	74	46
Dental research	19	50	26
Occupational diseases	160	269	42
Anesthesia and analgesia	56	209	98
Venereal diseases	− 66	− 85	− 56

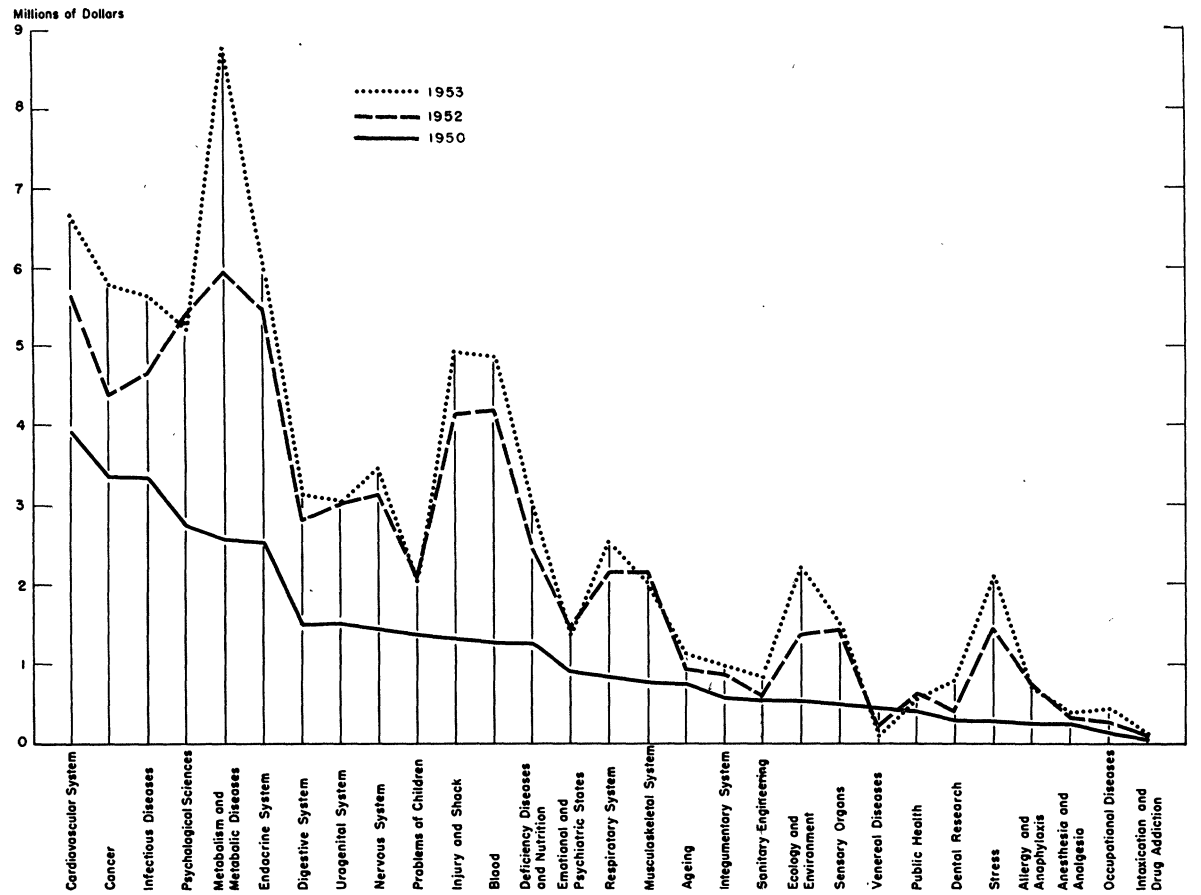

Fig. 4. Amounts awarded multiple subject categories from government sources.

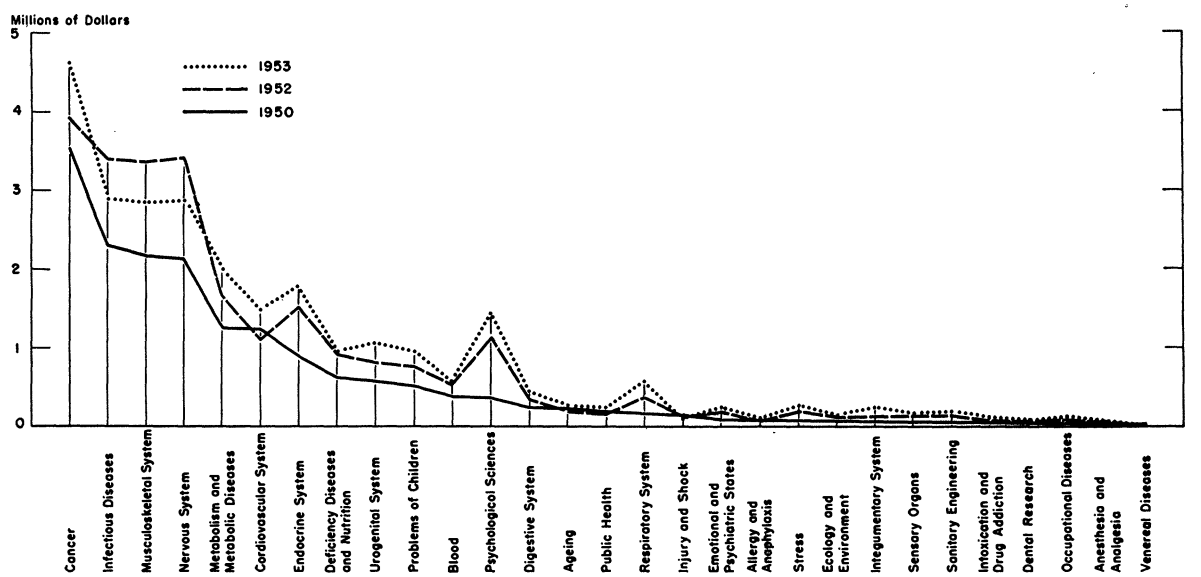

Fig. 5. Amounts awarded multiple subject categories from nongovernment sources.

TABLE 12. Order of magnitude of support of selected major multiple subject categories, amounts from all sources.

Millions of dollars	1950	1952	1953
10–11			Metabolism and metabolic diseases Cancer
8– 9		Cancer Infectious diseases	Infectious diseases Cardiovascular system
7– 8		Metabolism and metabolic diseases Endocrine system	Endocrine system
6– 7	Cancer	Cardiovascular system Nervous system Psychological sciences	Psychological sciences Nervous system
5– 6	Infectious diseases Cardiovascular system	Musculoskeletal system	Blood Injury and shock
4– 5		Blood Injury and shock	Musculoskeletal system Urogenital system
3– 4	Metabolism and metabolic diseases Nervous system Endocrine system Psychological sciences	Urogenital system Deficiency diseases and nutrition Digestive system	Deficiency diseases and nutrition Digestive system Respiratory system
2– 3	Musculoskeletal system Urogenital system	Problems of children Respiratory system	Problems of children Ecology and environment Stress
1– 2	Deficiency diseases and nutrition Problems of children Digestive system Blood Injury and shock Respiratory system	Emotional and psychiatric states Stress Sensory organs Ecology and environment Ageing	Sensory organs Emotional and psychiatric states Ageing Integumentary system Sanitary engineering

lic health," "Allergy and anaphylaxis," "Dental research," "Anesthesia and analgesia," "Occupational diseases," and "Intoxication and drug addiction" has been awarded a million dollars or more in any of the 3 years, the money available in 1953 is at least twice as great as in 1950 in three of these categories, and of the remaining three, there was a 64 percent increase in "Anesthesia and analgesia," a 95 percent increase in "Intoxication and drug addiction," and a 28 percent increase in "Public health." In view of the relatively small sums involved, no great significance can be attached to these findings.

Considering the percentage changes in funds from all sources awarded each major category in 1953 as compared with 1950 (Table 9), there was an increase of 100 percent or more in 14 categories. If the funds from government alone are examined, 17 categories were increased 100 percent or more (Table 10), while funds solely from nongovernment sources showed increases of this proportion in only 10 categories (Table 11).

The order of magnitude of support of these categories in each of the three years is demonstrated in Table 12. It portrays the growing emphasis on metabolic studies and the maintenance of high levels of support for research on cancer, research on cardiovascular, system and research on infectious diseases.

Figures 3, 4, and 5 illustrate the changes in order of magnitude in support of the selected major categories in 1952 and 1953 as contrasted with 1950. It is clear that government sources are largely responsible for the changes in emphasis of subject field and that nongovernment funds are distributed in more nearly the same fashion in all 3 years.

An examination of the distribution of funds within each of these major multiple subject categories has not disclosed changes sufficient either to merit a discussion or to justify publishing detailed tables. The tables are available, upon request, from the Exchange.

The foregoing presentation is based upon the circumscribed body of data defined in the first several paragraphs of this report. The funds, therefore, are not to be construed as representing the total support of research in the bio-sciences. Further, no reliable estimate can be offered as to what percentage of the total support these funds represent, although the amounts involved, 48 to 56 million dollars, are not inconsiderable.

The intent of this report is to present the material rather than to draw conclusions from it. The following brief resumé, therefore, sets forth only a few of the facts emerging from the analysis of these data:

the mounting funds available for research in the biosciences from both government and nongovernment sources; the growing number of investigators receiving research awards, especially the many new names that appear each year; and finally, the shift in the pattern of order of support of subject categories evidenced in government-supported research as contrasted with the relative stability of the pattern in nongovernment-supported research.

References and Notes

1. S. L. Deignan and E. Miller, *Science* **115**, 321 (1952).
2. In this report the term *grant* is used to mean an amount of money approved for the support of a project for the period of 1 year and refers to both grants and contracts.

Verbal Habits and the Visual Recognition of Words

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There is considerable experimental evidence that the threshold of visual recognition for words varies with the familiarity of the stimuli. Significant correlations have been found between the recognition thresholds for words and the frequencies with which these words occur in written English (*1–4*). The question remains open, however, whether it is the frequency of past visual exposure to the stimuli *per se* or frequency of past usage of the words that is the essential variable. The following experiments are concerned with this problem.

Experiment I. Visual recognition thresholds were determined for 27 three-letter English words. The words were chosen so as to represent (i) different frequencies of usage as English words, and (ii) visual stimulus patterns of different frequencies of occurrence. Estimates of frequency of usage are provided by the Thorndike-Lorge word counts (*5*). These counts are based on large samples of written English but do not, of course, measure the actual frequency of usage in spoken English. For our purposes, they provide estimates of the frequencies with which we respond to different combinations of letters as *word units.*

A given three-letter combination may not only be a word in its own right but also form part of a variety of other words. Thus, the three-letter sequence *fin* not only is a meaningful word but also forms part of other words, such as *finger, define, finish.* Such three-letter sequences, regardless of whether or not they form meaningful English words, are designated as *trigrams.* The relative frequencies of trigrams in written English may be used to estimate the frequencies with which they function as visual stimuli in reading. Such a trigram count has been published by Pratt (*6*).

For three-letter sequences, the frequency of usage as words and the frequency of occurrence as trigrams are, to a considerable degree, independent. For a sample of 356 words that appear both in Pratt's trigram count and in the Thorndike-Lorge word counts, the correlation between the two measures is .30. For our experimental sample of 27 words, the correlation is .20.

The stimulus words and their frequency values as words and as trigrams appear in Table 1. The word counts refer to frequencies of occurrence in samples of 4½ million words; the trigram count is based on relative frequencies in a sample of 20,000 words. Since the ranges of frequencies are wide, it is appropriate to scale them logarithmically (*7*). When the two frequency scales are divided into high, medium, and low values, the stimulus words sample all possible combinations of values of the two variables.

The words were presented for recognition by means of a slide projector. The order of presentation was random. The speed of exposure, controlled by a photographic shutter, was held constant at 0.01 sec. Variations in the brightness of the flash were used to determine the threshold of recognition. Starting at a fixed low intensity, the flash intensity was increased in 1-v steps on each successive trial. Fourteen such exposures were given for each word; this was a sufficient number of exposures to insure recognition by virtually all subjects. The number of exposures required for recognition was used as the measure of the threshold. Twenty-one students at the University of California served as subjects.

To make the recognition scores of different subjects comparable, all threshold measures were converted into standard scores. Scatter plots of the thresholds as a function of the two frequency variables are presented in Fig. 1. The higher the frequency of word usage, the lower the recognition threshold tends to be. The product-moment correlation is $-.39$, which is significantly different from zero at the 5-percent level of confidence.

As Fig. 1 shows, there is no relationship between recognition thresholds and the trigram frequency of the words. The product-moment correlation is .09, which is not significantly different from zero, and in