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**A COMPARISON
OF US AND SOVIET PROFESSIONAL MANPOWER**



May 1963

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A COMPARISON
OF US AND SOVIET PROFESSIONAL MANPOWER

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FOREWORD

This report presents comparative data on the number of college graduates in the US and the USSR, with a breakdown by field of study for those employed in the civilian labor force. It also presents an assessment of the engineering manpower resources of the two countries, in which a distinction is drawn between (1) college graduates who majored in engineering, and (2) all persons employed as engineers regardless of their educational background. The major purpose of this report is to illustrate the importance of this distinction in any comparative assessment of the professional manpower resources of the US and the USSR.

The data in this report relate in general to early 1959. The census of population conducted by the USSR in January 1959 provided information about professional manpower that is not available in similar detail for any other period. For purposes of comparison, US data for 1959 were used, even though more recent figures were available in unpublished form. The available data for 1960-62 indicate that although the size of the professional manpower pool has increased in both countries, the patterns of employment prevailing in 1959 have not changed significantly.

CONTENTS

	<u>Page</u>
Summary and Conclusions	1
I. Introduction	3
II. College-Graduate Manpower	4
A. In the Population, the Labor Force, and the Armed Forces	4
B. In the Civilian Labor Force, by Major Field of Study	6
1. Scientific and Technical Fields	6
a. Engineering	6
b. Physical and Life Sciences	8
c. Agriculture and Forestry	8
d. Health Fields	8
2. Education	9
3. Other Fields	9
C. Employment of College-Graduate Manpower	10
1. Relationship Between Occupation and Field of Study	10
2. Employment of College Graduates as Managers and Officials	12
III. Engineering Manpower	15

Appendixes

Appendix A. Definitions and Problems of Comparability . .	19
Appendix B. Sources and Methodology for Tables 1 and 2 and Figure 3	21
Appendix C. Fields of Study Offered in Higher Educational Institutions of the US and the USSR	29
Appendix D. Source References	45

[p. iv blank]

Tables

	<u>Page</u>
1. College Graduates in the Population and Labor Force of the US and the USSR, 1959	4
2. College Graduates in the Civilian Labor Force of the US and the USSR, by Field of Study, 1959 . . .	7
3. Male College Graduates in the Civilian Labor Force of the US, by Field of Study and Occupation, 1953 . .	11
4. Employment in Selected Managerial Occupations in the USSR, January 1959	14
5. A Soviet Comparison of College-Graduate Engineers Employed in the US and the USSR, Selected Years, 1940 and 1950-60	18
6. Derivation of Estimates of College Graduates Employed in the Civilian Labor Force of the US in March 1959 .	23
7. Derivation of Estimates of College Graduates Employed in the Civilian Labor Force of the USSR, December 1958	26

Charts

Figure 1. US and USSR: College Graduates in the Population and Labor Force, 1959	1
Figure 2. US and USSR: College Graduates in the Population and Labor Force, by Sex, 1959	5
Figure 3. Engineering Manpower and Its Employment in the Civilian Labor Force of the US, 1959	16

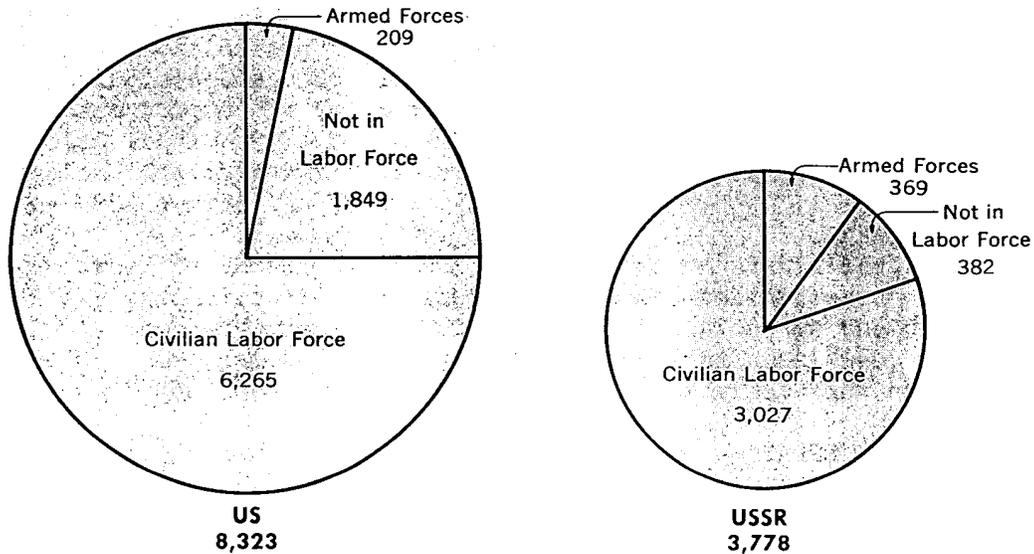
A COMPARISON
OF US AND SOVIET PROFESSIONAL MANPOWER

Summary and Conclusions

The professional manpower resources of the US and the USSR differ sharply as to size, composition, and employment. In 1959 (the most recent year for which comparable data are available), there were 8.3 million college graduates in the US and only 3.8 million in the USSR. About 50 percent of the employed graduates in the US had specialized in scientific and technical fields or education, whereas the number of such specialists in the USSR amounted to almost 90 percent of the total. In the USSR, therefore, because very few graduates were trained in the liberal arts and the humanities, many technically trained personnel found themselves in managerial and administrative positions. Thus, in the US, about three-fourths of the engineering graduates end up as engineers, but in the USSR only about one-half do so. In the US, only about 4 percent of the total number of male college graduates are members of the armed forces; in the USSR, the figure is 19 percent. The relative numbers of US and Soviet college graduates and their utilization in the labor forces of the two countries are summarized in the accompanying chart, Figure 1.

Figure 1

US and USSR
COLLEGE GRADUATES IN THE POPULATION AND LABOR FORCE
1959
IN THOUSANDS



I. Introduction

During the past decade, increasing attention has been focused on the growing disparity between the numbers of college graduates trained in certain specialties in the US and in the USSR. Statistical comparisons have been used to dramatize existing or predicted shortages in the US -- in engineering and medicine, for example -- as well as to illustrate the relatively greater emphasis in the USSR on education for science and technology.

During the 1950's, about 711,000 engineers were graduated from Soviet colleges but only 325,000 from US colleges. In 1951 the USSR surpassed the US in the number of engineers graduated, and since then the difference has been growing. In 1950, US colleges awarded 53,000 first-level (bachelors) degrees in engineering, and the USSR awarded 37,000. By 1960 the US figure had declined to 38,000, but the Soviet figure had increased to 120,000. 1/*

The relative size of the classes currently enrolled in engineering schools in the US and the USSR indicates that the difference between the numbers of graduations will become even wider over the next several years. Between 1957 and 1960, freshman enrollments in engineering schools declined in the US from 79,000 to 68,000 but increased in the USSR from 178,000 to almost 260,000. 2/

The US Bureau of Labor Statistics has estimated that an average of 72,000 engineering graduates will be needed annually to meet the nation's projected requirements during the 1960's. 3/ These requirements are greater than the expected supply -- based on current trends in enrollments -- and are considerably below the supply of engineering graduates in the USSR that apparently has been projected by the Soviet planners. Considering the size of the current freshman class in Soviet engineering schools, the number of engineering graduations probably will reach 200,000 by the academic year 1966/67. Thus, even if the projected requirements for the US are met, the statistical comparisons of engineering manpower will continue to be overwhelmingly in favor of the USSR during the 1960's.

In order to assess the significance of these statistics, it is necessary to understand that engineering graduates are used more extensively in managerial and administrative positions in the USSR than in the US. Because of its utilitarian educational policies, the USSR has no colleges that offer general education programs such as are

* For serially numbered source references, see Appendix D.

usually provided in US colleges. As a result, Soviet college graduates consist almost exclusively of specialists, whereas US college graduates include large numbers of generalists as well as specialists.

II. College-Graduate Manpower

A. In the Population, the Labor Force, and the Armed Forces

In 1959, there were more than twice as many college graduates in the US as in the USSR, 8.3 million compared with 3.8 million* (see Table 1). About 78 percent of the graduates in the US and 90 percent of those in the USSR were in the labor force. The percentage was higher in the USSR because a larger proportion of Soviet than US women who completed college were in the labor force. The proportion of male college graduates in the labor force of both countries, on the other hand, was estimated to be about the same (see the accompanying chart, Figure 2**). In the USSR, however, about 19 percent of the male

Table 1

College Graduates in the Population
and Labor Force of the US and the USSR a/
1959

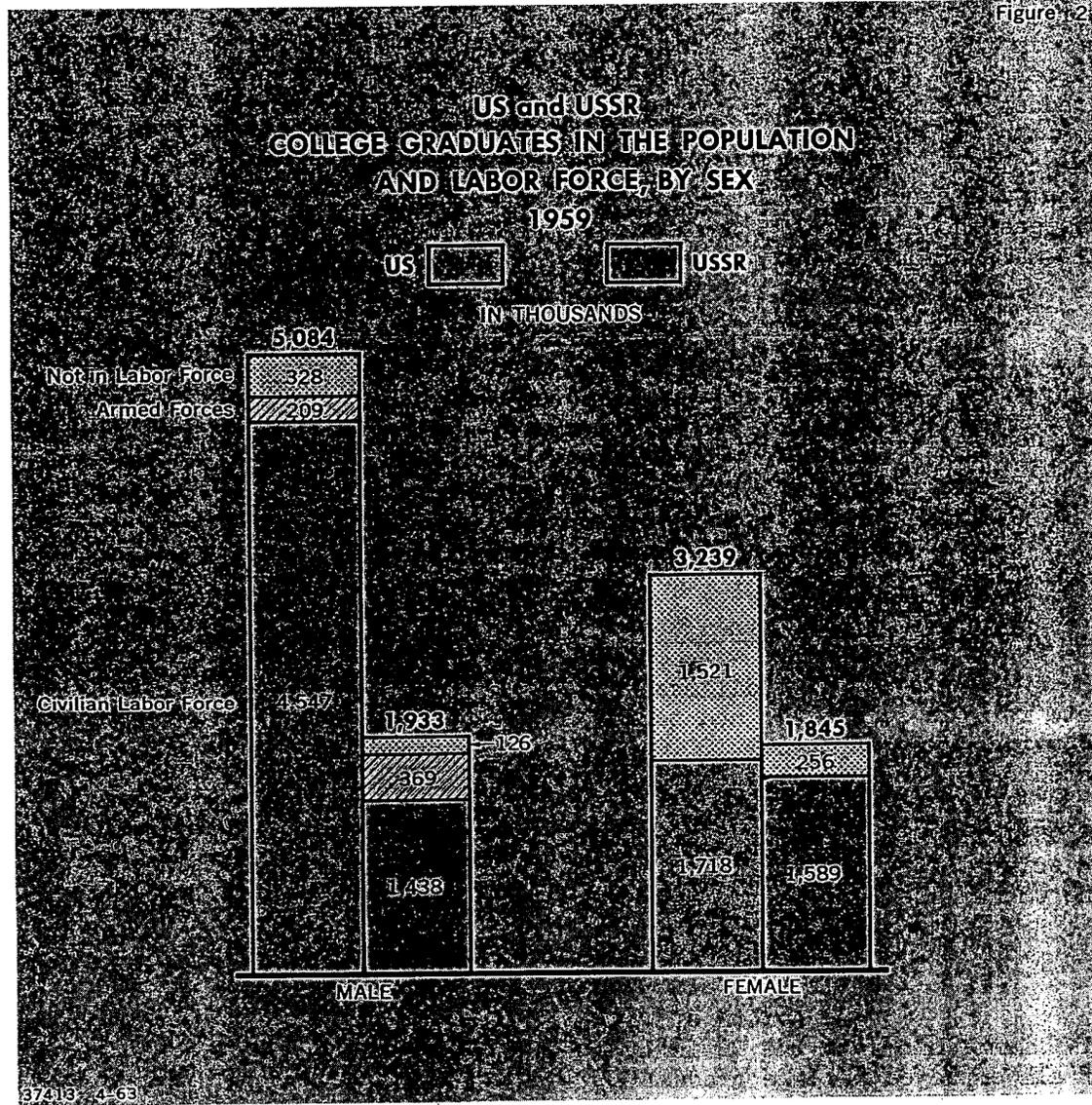
	Thousand Persons					
	US			USSR		
	Both Sexes	Male	Female	Both Sexes	Male	Female
Total college graduates	8,323	5,084	3,239	3,778	1,933	1,845
In the labor force	6,474	4,756	1,718	3,396	1,807	1,589
Armed forces	209	209	Negl.	369	369	Negl.
Civilian labor force	6,265	4,547	1,718	3,027	1,438	1,589
Not in the labor force	1,849	328	1,521	382	126	256

a. For sources and methodology, see Appendix B.

* In 1962 these figures were 9.7 million for the US and 4.7 million for the USSR. 4/

** Following on p. 5.

Figure 12



graduates were in the armed forces compared with only 4 percent in the US. Thus, in spite of the much higher rate of labor force participation among Soviet female college graduates, the number employed in the civilian economy of the US (6.3 million) also was more than twice the number in the USSR (3.0 million).

In relation to total military manpower the percentage of college graduates in the armed forces of the USSR in 1959 was only slightly

higher than in the US. Thus, of the 3.6 million men reported to be in the Soviet armed forces in 1959, 5/ about 370,000 (or 10 percent) were college graduates, whereas for the same year, of the 2.5 million men in the US armed forces, about 200,000 were college graduates (8 percent). 6/ However, the effect of this military use of college-graduate manpower on the available supply of male college graduates for the civilian economy was far greater in the USSR than in the US. The college graduates in the armed forces of the USSR represented about 19 percent of all the male college graduates in the nation, whereas those in the US armed forces represented only 4 percent of all male graduates.

B. In the Civilian Labor Force, by Major Field of Study

In 1959, college graduates who had majored in scientific and technical fields (engineering, science, agriculture and forestry, and the health fields) represented about one-third of all employed graduates in the US but more than one-half of those in the USSR (see Table 2*). In contrast, those who had majored in the social sciences, the humanities and arts, business, and law represented about one-half of all employed graduates in the US but only one-eighth of those in the USSR.

1. Scientific and Technical Fields

Because of differences in classification, the Soviet estimate for the scientific and technical fields probably should be adjusted upward by about 200,000. Science-teaching majors, who numbered about 200,000 in the USSR in 1959, were classified under "Education" in Soviet data but under "Sciences" in US data.** With this adjustment the total number of employed college graduates who majored in scientific and technical fields is estimated to be 2.2 million for the US and 1.8 million for the USSR.

a. Engineering

The number of graduate engineers employed in the civilian economy of the US in 1959 was about 720,000, or 11 percent of all employed college graduates, and in the USSR 894,000, or 30 percent. The USSR estimate includes graduates in certain physical

* Table 2 follows on p. 7.

** See Appendix C. Nicholas DeWitt has estimated that 250,000 of the 4.1 million persons who graduated from a Soviet institution of higher education (vyssheye uchebnoye zavedeniye -- vuz) between 1928 and 1959 were science majors in pedagogical vuzes. 7/ Because only 3.0 million graduates of vuzes were employed in 1959, the number of science-teaching majors who were employed probably was about 200,000.

Table 2

College Graduates in the Civilian Labor Force
of the US and the USSR, by Field of Study a/
1959

Field of Study	Thousand Persons	
	US	USSR <u>b/</u>
Total	6,265	3,027
Scientific and technical	2,217	1,641
Engineering	720	894
Physical and life sciences	705	134
Agriculture and forestry	195	209
Health fields	597	404
Education	1,030	1,009
Business, economics, and law	1,276	238
Other	1,742	139
Social sciences (except economics)	535	N.A.
Humanities and arts	647	N.A.
Miscellaneous fields <u>c/</u>	560	N.A.

a. For sources and methodology, see Appendix B.

b. Unadjusted for differences in classification, especially the category "physical and life sciences." For modifications and interpretations of the data, see the appropriate sections in the text.

c. Including journalism, library science, social work, home economics (in the US), and other fields not elsewhere classified.

sciences* who are not included in the US estimate but excludes engineer-economists,** whose training is analogous to that of industrial engineers

* Cartography, geochemistry, geodesy, geology, hydrography, hydrology, and meteorology. In addition, architecture is classified under engineering in the USSR but as a separate field in the US (see Appendix C).

** Although engineer-economists generally are trained in engineering institutes in the USSR, their classification as economists rather than as engineers in published statistics on employed graduates from vuzes is indicated by a comparison of the specialties in Appendix C with the detailed distribution [footnote continued on p. 8]

who are included in the US estimate. ^{10/} The net effect of these classification differences is an overstatement of the USSR estimate, in relation to the US estimate, of probably about 50,000.*

b. Physical and Life Sciences

A comparison of the number of persons who majored in the physical and life sciences (including mathematics) requires some major adjustments of the estimates shown in Table 2. As noted above, the USSR classifies science-teaching majors under "Education" and certain physical sciences under "Engineering." In relation to the US estimate of the number who majored in the physical and life sciences, therefore, the USSR estimate shown in Table 2 is understated by roughly 300,000. After adjustments the estimates indicate that about 700,000, or 11 percent, of all graduates had majored in the physical and life sciences in the US and about 450,000, or 15 percent, in the USSR.

c. Agriculture and Forestry

The inclusion of veterinary medicine under health fields in the US but under agriculture in the USSR reduces slightly the comparability of the estimates of college-graduate manpower for this category. The addition of about 19,000 veterinarians ^{12/} would raise the US estimate to 214,000, or approximately the same as the USSR estimate.

d. Health Fields

Of the 400,000 employed graduates who majored in health fields in the USSR in 1959, about 365,000, or more than 90 percent, were trained as physicians. The remaining 10 percent majored in physical culture or pharmacy. In the US, on the other hand, less than half were trained as physicians.** In addition to physicians, graduates in health fields in the US include persons who had majored in dentistry, medical technology, nursing, osteopathy, optometry,

of employed specialists appearing in source ^{8/}. On the other hand, as noted by DeWitt, ^{9/} engineer-economists apparently are included with engineers in statistics relating to annual graduations from Soviet vuzes.

* DeWitt has estimated that, out of all those graduating in the USSR between 1928 and 1959 (the number of which exceeds the number of employed graduates in 1959), about 111,000 majored in the physical sciences as defined in the US but classified as engineering in the USSR and that about 56,000 majored in engineering economics. ^{11/}

** See Appendix B.

pharmacy, podiatry, public health, and various other fields allied to the medical profession. In the USSR, some of these specialties -- such as dentistry, medical technology, and nursing -- are offered only in a semiprofessional school (tekhnikum).* Many of these specialties are nonexistent in the USSR, however, and the types of services involved are provided by physicians.

2. Education

In the USSR the category "Education" includes all graduates who majored in one of the specialized fields as listed under "Specialties in Pedagogical and Library Institutes" in Appendix B. Included among them, therefore, would be graduates who majored in the physical and life sciences specifically to teach those subjects, as well as majors in library science and "cultural education." In the US, as noted above, teachers with degrees in biology or the physical sciences are classified in the field of their subject matter rather than in education. Moreover, library science and those fields of study in the US analogous to "cultural education" in the USSR -- such as religion and social work -- are not included in the category "Education" in the US as they are in the USSR. The estimates shown in Table 2, therefore, overstate the number of education majors in the USSR in relation to the number in the US. The amount of overstatement, however, cannot be determined from the available data.

3. Other Fields

The number of employed graduates in the USSR in 1959 who majored in business, law, the social sciences, and the humanities and arts is estimated at about 400,000, or only 12 percent of all graduates, compared with about 3 million, or almost 50 percent, in the US. The neglect of college training in these general fields in the USSR, in contrast to the heavy emphasis on these fields in the US, represents a fundamental distinction between the college-graduate manpower resources of the two countries. In place of a general education, as the term is generally used in the US, the USSR has trained its high-level manpower almost exclusively in specialized fields. The engineer is the Soviet ideal of the properly educated industrial administrator, whereas the person with the rounded background in college is prominent in the administration of the US economy. 14/ In both countries the available college-graduate manpower resources, regardless of formal training, represent the principal source of high-level manpower not

* Although the USSR trains dentists only in its tekhnikums, it also trains stomatologists (physicians specializing in dentistry) in its medical colleges. About 14,000 stomatologists were included among the 365,000 physicians in the USSR in 1959. 13/

only for working-level positions in the specialized fields but also for leadership and administrative direction. The positions actually held by the employed college graduates of the US and the USSR are discussed below.

C. Employment of College-Graduate Manpower

The term employment as used in this report refers to the positions actually held by college graduates as indicated by their occupations. This is a limited approach to the problem of utilization because it illustrates only the jobs in which college graduates are used, without reference to the functions that are performed on these jobs. It does not take into account, moreover, how well they are used or how their time is allocated among the various duties connected with their jobs. This approach, nevertheless, permits a general evaluation of the contribution of college-graduate manpower to the economy. An over-all evaluation of the relative degree of utilization of college-graduate manpower in the two countries would involve a host of subjective considerations and is beyond the scope of this report.*

1. Relationship Between Occupation and Field of Study

For various reasons, the job title held by a college graduate may not correspond to the title of the field of study in which he majored while in college. This lack of correspondence does not mean necessarily that the graduate has abandoned his training or that he is employed in an occupation that does not require college training. For the most part, in both the US and the USSR it reflects the numerous job opportunities available to the graduate -- first at the working level and later at the management level -- during his working life. An additional reason in the US is that in college study as well as in later work there are opportunities for generalists as well as specialists.

The diverse backgrounds of business executives and public officials in the US may be illustrated by citing the educational backgrounds of 1,700 top executives surveyed by Fortune in 1959 17/ and the professional backgrounds of the members of the Senate and House of Representatives in 1960. 18/ Of the 1,100 college graduates among the top executives, 18 percent had majored in liberal arts, 39 percent

* A discussion of "good utilization" of educated specialists may be found in a study by Dael Wolfle, Director of the Commission on Human Resources and Advanced Training. 15/ DeWitt, in his comparison of college graduates in the US and the USSR, discusses utilization with reference to the "locus" of employment -- that is, the distribution of college graduates among the various branches of the economy, such as industry and agriculture. 16/

in science and engineering, and the remaining 43 percent in law, business, and economics. Members of the US Senate included 62 lawyers, 2 engineers, 13 journalists, 1 doctor, and 22 with backgrounds in other fields. Members of the House of Representatives included 243 lawyers, 3 engineers, 4 doctors, 36 journalists, and 147 with backgrounds in other fields.

According to Wolfle, only 38 percent of the employed college graduates in the US in 1953 were working in the fields in which they majored as undergraduates. ^{19/} The Commission found that, except for a few fields such as medicine, law, and engineering, college graduates typically had shifted into business or administration, other professional fields, and even into nonprofessional work (see Table 3).^{*} A relatively small proportion of the graduates who had majored in such general fields as the social sciences or the humanities and arts were employed in occupations corresponding to their fields of study. On the

Table 3
Male College Graduates in the Civilian Labor Force of the US
by Field of Study and Occupation ^{a/}
1953

Field of Study	Percentage Distribution				
	All Occupations	Same as Field of Study	Business and Administration	Other Professional Fields	Nonprofessional Work
Natural sciences	100	27	16	50	7
Social sciences	100	6	38	37	19
Humanities and arts	100	26	17	40	17
Engineering	100	70	16	3	11
Agriculture	100	52	17	9	22
Health fields	100	94	3	1	2
Business and commerce	100	b/	64	6	30
Education	100	40	22	19	19
Law	100	77	16	2	5

a. Adapted from source ^{20/}.

b. Included under Business and Administration.

* Although the data in Table 3 relate only to males, the Commission's findings were about the same for both males and females in the labor force.

other hand, the vast majority of those who majored in the health fields, in law, and in engineering were employed in the professions in which they were trained.

The data in Table 3 also show that US graduates with a general educational background were more likely to enter managerial and administrative occupations than those with a specialized background. Graduates in business and commerce were the most likely to do so, although a fairly large proportion of the graduates in the social sciences also entered such occupations. On the other hand, only about one-sixth of the graduates in such specialized fields as engineering, science, law, and agriculture were employed in administrative occupations.

In the USSR, in sharp contrast to the US, there are no opportunities for a general higher education. As illustrated in the data on fields of training shown in Table 2,* graduates from Soviet higher educational institutions have been trained for a specific occupational specialty. Even under those circumstances, however, the occupation of a college graduate in the USSR may not correspond to the occupation suggested by his field of study. As indicated above, this does not mean necessarily that the graduate has abandoned his training or that he is employed in an occupation that does not require a higher education. On the contrary, the USSR's policy of directed placement of specialists forces the majority of graduates of higher educational establishments to embark immediately on graduation on jobs that largely coincide with their field of training.** Nevertheless, college graduates are used extensively in the USSR -- just as in the US -- in managerial and administrative occupations. In contrast to the US, however, the college graduates who are employed in the USSR as administrators, managers, and Party and government officials -- because of the nature of the educational system that trained them -- are persons who majored in specialized fields.

2. Employment of College Graduates as Managers and Officials

An approximation of the number of college graduates employed in managerial and administrative occupations in the US may be obtained by reference to the occupational category "Managers and Officials" in the statistics published by the US Bureau of Labor Statistics. In 1959, out of 3.4 million persons employed in those occupations, about 650,000 -- or about one-fifth of the total -- were college graduates. A total of 250,000 additional college graduates was employed as "proprietors," mainly shopkeepers and owners of small businesses. 22/

* P. 7, above.

** For a discussion of Soviet placement procedures and their effectiveness, see source 21/.

about 900,000 graduates, or 15 percent of all graduates in the civilian labor force, were employed in managerial, administrative, and proprietary occupations.

Information relating to the fields of study in which these graduates majored while in college is not available in official US publications. The surveys conducted by the Commission on Human Resources and Advanced Training and by Fortune, cited above,* permit some general observations. Probably more than half had majored in the fields of business administration, law, the humanities and arts, and the social sciences. Although engineers may have constituted a sizable proportion of top management in industry, their employment as managers, officials, and proprietors in other sectors of the economy probably was quite limited.

The USSR has not published an occupational distribution of its college graduates, but rough estimates of the number of college graduates in managerial occupations may be constructed from data relating to total employment in such occupations (see Table 4**). Of the various occupations listed in the Soviet statistics, only those that were readily identifiable as managerial are included here. The total number -- 2.2 million -- cannot be compared with the estimate of 3.4 million "Managers and Officials" in the US, cited above.

The number of college graduates among these Soviet managers probably ranged between 650,000 and 700,000 in 1959. This rough estimate was based on judgments regarding each of the managerial occupations shown in Table 4. Among the first five occupations listed, which included 1.2 million government officials and the managers above the foreman level in industry, construction, transportation, communications, and state agriculture, probably almost one-half were college graduates. The predominance of college graduates among the 392,100 government and Party functionaries (see Table 4) is suggested by the number of graduates reportedly employed in all government departments and Party organizations in 1959 -- almost 300,000. 23/ Most of these graduates probably were employed in managerial and administrative rather than technical positions. Among the 280,000 directors of enterprises, David Granick 24/ and various Soviet sources*** have

* See 1, p. 10, above.

** Table 4 follows on p. 14.

*** In 1960, about 86 percent of the heads of communications administrations and 50 percent of their deputies were college graduates. 25/ In 1959, 43 percent of the plant directors in the cement industry were college graduates. 26/ In the Moscow Oblast in 1962, about 65 percent of state farm directors were college graduates. 27/

Table 4

Employment in Selected Managerial Occupations in the USSR a/
January 1959

Occupation	Thousand Persons
Heads of state administrative organs and their structural subdivisions	246.6
Heads of Party, Komsomol, trade union, cooperative, and other social organizations and their subdivisions	145.5
Directors, chiefs, and managers of enterprises	280.0
Chiefs of technical-production branches, sectors, groups, and bureaus	132.5
Leaders of shops, bays (<u>prolety</u>), workshops, and sections	361.3
Chairmen of collective farms and their deputies	102.8
Chairmen of industrial artels and collectives	78.6
Heads of publishing houses and their subdivisions	5.6
Directors of theaters, movies, parks, museums, and exhibits	7.4
Directors and managers of stores and heads of trade organizations	334.8
Managers of restaurants (except cafeterias)	57.5
Managers of procurement, supply, and sales organizations	403.8
Chiefs of planning, financial and economic accounting, and statistical branches of enterprises and organizations	47.9
Managers of clerical branches and offices of enterprises and organizations	17.3

a. 28/. Occupations treated as residuals in sources are identified in source 29/.

indicated that in the late 1950's, on the average, considerably more than half were college graduates. Among the 493,800 subordinates of these directors (branch chiefs and shop and section leaders) the proportion of college graduates probably is lower than among the directors themselves -- perhaps one-third. These five occupations, therefore, probably accounted for about 550,000 college graduates in 1959.

For the other managerial occupations shown in Table 4, information on educational attainment is available only for the collective farm chairmen and their deputies, 9 percent of whom were college graduates in 1959. 30/ It is estimated that the proportion of college graduates in these remaining managerial occupations probably averaged between 10 and 15 percent and that their number ranged between 100,000 and 150,000.

A distribution of these graduates by field of study is not available. It is estimated, however, that about three-fifths of them -- roughly 400,000 -- had majored in engineering. The remainder -- also specialists -- had majored in such fields as agriculture, economics, trade, and law. These estimates are based on the distribution of all employed graduates as shown in Table 2.*

III. Engineering Manpower

Because of the lack of correspondence between field of study and occupation, the number of persons employed in a particular occupation may not necessarily correspond to the number of employed college graduates who were trained specifically for that occupation. For this reason, it is desirable to use two separate but related approaches to an assessment of professional manpower, the first relating exclusively to college graduates on the basis of their field of study and the second relating to persons employed in professional occupations regardless of the amount or nature of their educational background. As suggested above, such an approach is indispensable when comparing two countries with different patterns of employment.

The nature and limitations of the available data preclude the application of this dual approach to comparisons of all categories of professional manpower. With the available data, however, it is possible to illustrate the implications of this dual approach to comparisons of engineering manpower in the US and the USSR.

Two types of estimates of engineering manpower for the US, representing the two approaches described above, are shown in the accompanying chart, Figure 3.** The Type I estimates relate only to college graduates who majored in engineering; the estimate of the number employed in the civilian labor force (720,000) and its comparable estimate for the USSR (about 850,000) have been discussed above.***

As shown in the chart, about 543,000, or three-fourths of these US engineering graduates, were employed as engineers.† Based on the

* P. 7, above. In order to construct the estimates, persons who majored in the physical and life sciences (134,000), the health fields (404,000), and education (1,009,000) are first subtracted from the total (3,027,000) because the managerial and administrative positions that such graduates are likely to hold are omitted from the positions listed in Table 4. The number of engineering majors (894,000) is then calculated to be about 60 percent of the remaining graduates.

** Following on p. 16.

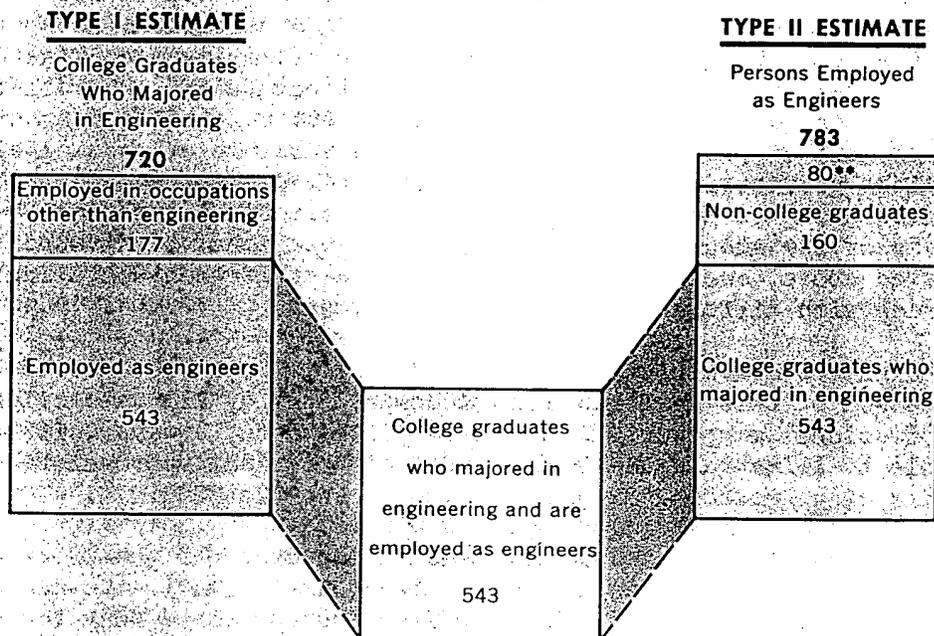
*** See II, B, 1, a, p. 6, above.

† According to the National Science Foundation, which sponsored the survey on which this estimate is based, [footnote continued on p. 16]

Figure 3

**ENGINEERING MANPOWER AND ITS EMPLOYMENT
IN THE CIVILIAN LABOR FORCE OF THE US, 1959***

IN THOUSANDS



- * For sources and Methodology, see Appendix B
- ** College graduates who majored in fields other than engineering

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"engineers" are defined as all persons engaged in engineering work that requires a knowledge of engineering, physical, life, or mathematical sciences equivalent at least to that acquired through completion of a 4-year college course with a major in these fields. Included are metallurgical, mechanical, chemical, electrical, and all other types of engineers engaged in research and development, production, management, technical sales, and all other positions that usually require an engineering background. 31/

findings of the Commission on Human Resources and Advanced Training cited above,* it may be estimated that between 50,000 and 100,000 of the 177,000 engineering graduates employed in other occupations were employed in "Business and Administration" -- mainly as managers or administrators -- and that most of the remainder were in nonprofessional positions.

The Type II estimates relate to the total number of persons employed as engineers, including not only the 543,000 engineering graduates cited above but also an estimated 80,000 graduates who majored in other fields** and about 160,000 noncollege graduates.

Although similar detailed data relating to the Type I estimates are not available for the USSR, some general observations may be made based on the estimates discussed above.*** As indicated there, an estimated 400,000 of the engineering graduates employed in the civilian economy were employed in managerial and administrative occupations. Perhaps 50,000 additional are employed as foremen, as scientists, or temporarily on initial assignment as nonprofessional workers. Consequently, only about one-half of the 894,000 engineering graduates employed in the civilian economy of the USSR in 1959 actually were employed as engineers, contrasting with about three-fourths of US engineering graduates who were so employed.

Similarly, with regard to the Type II estimates, the USSR has reported that in January 1959, based on the results of the 1959 census of population, about 834,000 persons were employed in occupations that were classified under the broad heading "engineers."† If it is assumed that few if any college graduates who majored in fields other than engineering†† are employed as engineers, then this estimate of 834,000 includes about 450,000 engineering graduates and almost 400,000 noncollege graduates. Thus close to half of the persons employed as engineers in the USSR are noncollege graduates compared with only one-fifth in the US.

* See II, C, 1, p. 10, above, and Table 3, p. 11, above.

** Primarily the physical sciences or mathematics.

*** See II, C, 2, p. 12, above.

† 32/. With few exceptions, persons employed in these occupations were classified as engineers regardless of their educational background. 33/

†† In the US the college graduates employed as engineers who had majored in a field other than engineering were primarily physical science majors. Unlike the US, however, the USSR classifies most of its physical science majors as engineering graduates (see II, B, 1, a, p. 6, above).

Comparisons of engineering manpower that have appeared in official publications of both the US and the USSR generally have equated the number of engineering graduates employed in the entire civilian economy of the USSR with the number of engineering graduates employed in engineering positions in the US. Estimates based on these different concepts, for example, were cited in a comparison presented before the US Congress in 1960. In that comparison, "nearly 1 million professionally trained engineers, typically with at least a 5-year engineering institute diploma" in the USSR were compared with "engineers in the United States [who] numbered about 850,000 in 1959, and perhaps a third or more of them did not possess a formal academic degree" ^{34/} This reckoning implies that there were only about 550,000 engineering graduates employed in the US compared with almost 1 million in the USSR.

Estimates that apparently were based on these different concepts also have appeared in Soviet publications. The comparison shown in Table 5, for example, appeared in the 1960 yearbook issued by the USSR Central Statistical Administration. The data for the USSR relate to the number of engineering graduates who were employed in the civilian economy. The data for the US apparently represent estimates prepared by the USSR of only the number of engineering graduates who were employed as engineers.

These comparisons would be valid only if all of the college-graduate engineers in the USSR actually were employed as engineers. Such an assumption, however, is inconsistent with the pattern of utilization in the USSR as discussed above.

Table 5

A Soviet Comparison of College-Graduate Engineers
Employed in the US and the USSR a/
Selected Years, 1940 and 1950-60

Year	Thousand Persons	
	US	USSR
1940	156	290
1950	316	392
1953	361	481
1958	485	894
1959	505	987
1960	525	1,080

a. ^{35/}. Estimates for the USSR are as of December, and estimates for the US probably are as of midyear.

APPENDIX A

DEFINITIONS AND PROBLEMS OF COMPARABILITY

1. Definition of a College Graduate

The term college graduate as used in this report refers to (1) persons in the US who have completed 4 years or more of college and (2) persons in the USSR who have received a "diploma" from a "higher educational institution" (vyssheye uchebnoye zavedeniye -- vuz). The difference between these two definitions reflects the manner in which each country compiles and publishes statistics on the educational attainment of its population. The US Bureau of the Census publishes information on educational attainment in terms of years of schooling, without indicating whether those with 4 years or more of college actually graduated. It is assumed, however, that the number of persons in the US who have completed 4 years or more of college is practically the same as the number of college graduates.* Soviet statistics on educational attainment, on the other hand, refer to the type of school attended without indicating the number of years of schooling. Some of the persons who are counted as college graduates in the USSR, for example, completed only 2 years of college.** In general, however, the period of college training in the USSR ranges from 4 to 6 years.*** 37/

2. Problems of Comparability

a. Sources and Reliability of the Data

A breakdown of the number of college graduates in the civilian labor force by field of study was estimated as of 1959, in accordance with the procedures outlined in Appendix B. The estimates for the USSR were based on official Soviet data published in statistical handbooks. The estimates for the US were based on data relating to the number of persons graduating from American colleges and universities since 1900. Because of the absence of official US statistics on the number of employed college graduates by field of study, it was necessary to estimate the number of living college graduates in each major field and to apply "labor force participation rates" to each of these estimates in order to determine the number of persons in each field that were employed in the civilian labor force in 1959.† The estimates for the US,

* The US Bureau of the Census, in interpreting its statistics, refers to persons with 4 years or more of college as "college graduates." 36/

** In teacher-training institutes, now defunct.

*** Differences in the quality of the education and of the student's work experience following graduation are beyond the scope of this report.

† For methodology, see Appendix B.

therefore, are approximations that should be treated only as rough indications of the order of magnitude.

b. Differences Between the Classification Systems

Listed in Appendix C are almost 200 "major fields" by which US college graduates were classified by the US Office of Education in 1959 and more than 300 "specialties" offered in Soviet higher educational establishments in 1959. The estimated breakdown of college-graduate manpower in the US and the USSR by major field of study, as shown in Table 2,* is based on these classification systems. The data for the US are grouped into areas of study analogous to those for which Soviet data were available.

* P. 7, above.

APPENDIX B

SOURCES AND METHODOLOGY FOR TABLES 1 AND 2 AND FIGURE 3

I. Table 1: College Graduates in the Population and Labor Force of the US and the USSR, 1959

A. US Data

1. Total college graduates. 38/ Data relate to March 1959.
2. College graduates in the labor force. The sum of the armed forces and the civilian labor force.
3. College graduates in the armed forces. The educational level of military personnel estimated by the US Department of Defense as of February 1960 39/; these estimates are applied to armed forces levels for November 1959. 40/
4. College graduates in the civilian labor force. 41/ Data relate to persons 18 years of age and over, with 4 years or more of college, in March 1959; including the employed and the unemployed.
5. College graduates not in the labor force. Obtained by subtracting the college graduates in the labor force from the total number of college graduates.

B. USSR Data

1. Total college graduates. 42/ Data relate to 15 January 1959.
2. College graduates in the labor force
 - a. Male. Estimated at 93.5 percent of all male college graduates. Participation in the labor force by male college graduates is assumed to be the same as in the US.
 - b. Female. Same as the number of college graduates in the civilian labor force.
3. College graduates in the armed forces. Obtained by subtracting the graduates in the civilian labor force from the graduates in the total labor force.
4. College graduates in the civilian labor force.

a. Both sexes. 43/ Estimate relates to December 1958.

b. Male. Obtained by subtracting female college graduates from both sexes.

c. Female. The percentage of females was reported for January 1958 (52 percent), 44/ and December 1959 (53 percent). 45/ The average of these percentages (52.5 percent) is applied to the estimate for both sexes for December 1958 to obtain the number of female college graduates as of that date.

5. College graduates not in the labor force. Obtained by subtracting the number in the labor force from the total number of graduates.

II. Table 2: College Graduates in the Civilian Labor Force of the US and the USSR, by Field of Study, 1959

A. US Data

An inventory of all of the college graduates in the US, distributed according to the fields in which they majored while in college, has never been compiled by any of the statistical agencies of the US Government. Wolfle, 46/ using data on annual graduations since 1900 from American colleges and universities, calculated estimates of the number of living college graduates as of 1953. These estimates appear in column 1 of Table 6.*

In order to update Wolfle's estimates to early 1959, the number of graduations in each field during 1954-58 were added. These numbers, as reported by the US Office of Education, 47/ are shown in column 2 of Table 6. Annual graduations include only persons who earned a bachelors or other first-level degree. The updated estimates of living graduates as of early 1959, with no account taken of deaths during 1954-58, are shown in column 3 of Table 6. By this method the total number of living graduates in 1959 was 7,453,000.

According to the US Bureau of the Census, however, the number of persons in the US with 4 years or more of college in March 1959 was 8,323,000. This estimate is shown in Table 1.** The Census estimate, based on a household survey, probably is slightly exaggerated. Nevertheless, considering the more serious limitations of an estimate based on institutional reports spanning more than half a century, the Census estimate is considered to be the more valid one. Each of the estimates in column 3 of Table 6, therefore, is multiplied by a factor of 1.1167 (8,323,000 divided by 7,453,000) to obtain the adjusted estimates in column 4.

* Table 6 follows on p. 23.

** P. 4, above.

Table 6

Derivation of Estimates of College Graduates
Employed in the Civilian Labor Force of the US in March 1959 a/*

Field of Study	(1)	(2)	(3)		(4)	(5)	(6)		(7)
	Living Graduates in 1953	Graduations 1954-58	Unadjusted	Adjusted	Living Graduates March 1959	Percent in Labor Force	Unadjusted	Adjusted	Thousands Persons
Total, all fields	5,856	1,597	7,453	8,323		b/	6,108 b/	6,265	
Engineering	529	147	676	755		93	702	720	
Natural sciences	643	164	807	901		b/	688 b/	705	
Chemistry	178	31	209	233		85	198	203	
Other physical sciences	171	41	212	237		74	175	179	
Earth sciences	60	15	75	84		77	65	67	
Biological sciences c/	234	77	311	347		72	250	256	
Agriculture and forestry	150	35	185	207		92	190	195	
Health fields	481	111	592	662		b/	582 b/	597	
Medicine	204	34	238	266		96	255	262	
Dentistry	93	15	108	121		95	115	118	
Other	184	62	246	275		77	212	217	
Business, economics, and law	1,043	305	1,348	1,505		b/	1,244 b/	1,276	
Business	580	227	807	901		81	730	749	
Economics	177	34	211	236		71	168	172	
Law	286	44	330	368		94	346	355	
Education	986	356	1,342	1,499		67	1,004	1,030	

* Footnotes for Table 6 follow on p. 24.

Table 6

Derivation of Estimates of College Graduates
Employed in the Civilian Labor Force of the US in March 1959 a/

Field of Study	Thousand Persons						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Living Graduates in 1953	Graduations 1954-58	Living Graduates March 1959		Percent in Labor Force	Graduates in the Civilian Labor Force	
			Unadjusted	Adjusted		Unadjusted	Adjusted
Other fields	2,024	479	2,503	2,794	b/	1,698 b/	1,742
Social sciences, except economics	499	189	688	768	b/	521 b/	535
History	181	54	235	262	68	178	183
Psychology	95	30	125	140	54	76	78
Other	223	105	328	366	73	267	274
Humanities and arts	851	189	1,040	1,161	b/	631 b/	647
English	317	72	389	434	52	226	232
Foreign languages	227	20	247	276	56	155	159
Philosophy	111	12	123	137	36	49	50
Fine arts d/	196	85	281	314	64	201	206
Miscellaneous fields	674	101	775	865	b/	546 b/	560
Home economics	147	28	175	195	33	64	66
Other professions e/	115	37	152	170	72	122	125
All other	412	36	448	500	72	360	369

a. For sources and methodology, see the appropriate sections in the text.

b. Totals and subtotals were obtained by adding the components.

c. Including general science.

d. Including general arts.

e. Including architecture, journalism, library science, and social work.

Wolfe also estimated, for 1953, the percentage of living graduates, in each field of study, that was in the labor force. ^{48/} These percentages, shown in column 5 of Table 6, were applied to the estimates in column 4 to calculate the distribution of employed graduates as shown in column 6. Summing these detailed results, an estimate of 6,108,000 employed graduates was obtained. This estimate is practically the same as the Census estimate of employed graduates in March 1959 -- 6,265,000 -- shown in Table 1.** The estimates in column 6 are adjusted to agree with the Census total; each estimate is multiplied by a factor of 1.0257 to obtain the estimates shown in column 7.

B. USSR Data

To obtain estimates for the USSR relating as closely as possible to early 1959, it was necessary to interpolate between published estimates for 1 December 1957 and 1 December 1959. The estimates in columns 1 and 2 of Table 7,* except for those in parentheses, appeared in a Soviet statistical handbook. ^{49/} The estimates in column 3 represent interpolations of the estimates in columns 1 and 2. In column 4 these estimates are adjusted to agree with the officially reported total number of employed graduates in the civilian labor force (3,027,000) shown in Table 1 and with the officially reported number of employed engineers (894,000) shown in Table 5.***

The estimates in parentheses in columns 1 and 2 of Table 7 were constructed as follows:

1. "Health specialists" and "Other health specialists"

The USSR reported that in December 1960 there were 443,627 employed college graduates who had majored in health fields. Of these graduates, 400,600, or 90.3 percent, were physicians. ^{50/} This percentage is applied to the reported number of physicians in 1957 and 1959 to derive estimates for the health specialists as a group. The category "Other health specialists" is obtained by subtraction.

2. "Teachers, librarians, and cultural-enlightenment specialists" and "university graduates"

Also for December 1960 the USSR reported that university graduates constituted 17.2 percent, and teachers, librarians, and cultural-enlightenment specialists constituted 82.8 percent, of the combined group in which they are normally reported. ^{51/} These percentages

* Table 7 follows on p. 26.

** P. 4, above.

*** P. 18, above.

Table 7

Derivation of Estimates of College Graduates
Employed in the Civilian Labor Force of the USSR a/
December 1958

	Thousand Persons			
	(1)	(2)	(3)	(4)
			Estimate for 1 December 1958	
	1 December 1957	1 December 1959	Unadjusted	Adjusted
Total	2,808.5	3,235.7	3,022.1	3,027
Engineers	816.1	986.6	901.4	894
Agronomists, zootechnicians, veterinarians, and foresters	193.1	222.4	207.8	209
Economists and economic- statisticians	145.2	177.6	161.4	162
Trade specialists	12.3	16.3	14.3	14
Lawyers	57.8	65.5	61.7	62
Health specialists	(383.2)	(419.3)	401.3	404
Physicians	346.0	378.6	362.3	365
Other health specialists	(37.2)	(40.7)	39.0	39
Teachers, graduates of uni- versities (except geologists, lawyers, physicians, and economists), librarians, and cultural-enlightenment specialists	1,144.9	1,278.9	1,211.9	1,219
Teachers, librarians, and cultural-enlightenment specialists	(948.0)	(1,058.9)	1,003.4	1,009
University graduates	(196.9)	(220.0)	208.5	210
Physical and life scientists	(123.6)	(142.4)	133.0	134
Other university graduates	(73.3)	(77.6)	75.5	76
Other specialists not elsewhere classified b/	55.9	69.1	62.5	63

a. For sources and methodology, see the appropriate sections in the text.
Because of rounding, components may not add to the totals shown.

b. Probably including persons trained in military specialties who are
employed in the civilian labor force.

are applied to the combined estimates reported for 1957 and 1959 to obtain individual estimates for these two categories.

3. "Physical and life scientists" and "Other university graduates"

Based on estimates calculated by DeWitt, about 4.4 percent of all persons who graduated from Soviet colleges and universities between 1928 and 1959 had majored in the mathematical, physical, and biological sciences at universities. ^{52/} It is assumed that this percentage is applicable to the employed university graduates in 1957 and 1959. Estimates for "Other university graduates" are obtained by subtraction.

III. Figure 3: Engineering Manpower and Its Employment in the Civilian Labor Force of the US, 1959

A. College graduates who majored in engineering

1. Total. From column 7, Table 6, p. 23, above.
2. Employed as engineers -- see B, below.
3. Employed in other occupations -- obtained by subtraction.

B. Persons employed as engineers

1. Total

The US Bureau of Labor Statistics estimates that 783,000 persons were employed in engineering positions in the US in 1959. This estimate, which is based on surveys of business firms and other institutions, includes "all persons who were engaged in engineering work at a level which required a knowledge of engineering, physical, life, or mathematical sciences equivalent at least to that acquired through completion of a 4-year college course with a major in these fields." ^{53/}

The US Bureau of the Census estimates that 853,738 persons* were employed in the occupational category "Engineers" on 1 April 1960. ^{54/} This estimate, based on the results of the 1960 Census of Population, is obtained by classifying the job titles, which were reported by individuals, in accordance with a predetermined classification system. About 350 different job titles were classified as engineering occupations. ^{55/} This

* Males only; the number of females employed as engineers, probably negligible, was not reported.

estimate differs from the one cited above, in part because of the later reference period but primarily because of the different underlying survey procedures. The estimate for 1959 prepared by the Bureau of Labor Statistics is used in this report because (1) its time reference is more comparable to that of the available estimate for the USSR, and (2) supplementary analytical material provided by the Bureau of Labor Statistics survey was used to estimate certain educational characteristics of the employed engineers (see 2, below).

2. College graduates who majored in engineering, college graduates who majored in other fields, and noncollege graduates

It is estimated by the US Bureau of Labor Statistics that in 1959 more than 20 percent of the persons employed in engineering positions in US industry did not have a college degree. An additional 10 percent had degrees but had majored in fields other than engineering. ^{56/} Thus, among the 783,000 persons employed in engineering positions in 1959, about 160,000 were noncollege graduates, 80,000 were college graduates who had not majored in engineering, and 543,000 were college graduates who had majored in engineering.

APPENDIX C

FIELDS OF STUDY OFFERED IN HIGHER EDUCATIONAL INSTITUTIONS
OF THE US AND THE USSR

I. Major Fields in Colleges and Universities in the US a/*

Agriculture b/

Agronomy, Field Crops
Animal Husbandry
Dairy Husbandry
Dairy Manufacturing, Dairy Technology
Farm Management, excluding Agricultural Economics
Food Technology
Horticulture (fruit and vegetable production)
Ornamental Horticulture (Floriculture, Nursery Management,
Landscape Gardening)
Poultry Husbandry
Soils (Soil Science, Soil Management, Soil Conservation)
Agriculture, other specific major fields
Agriculture, general (general agriculture curriculum, with-
out major specialization)
Agriculture -- not further classified

Architecture (excluding Architectural Engineering)

Biological Sciences c/

Premedical, pre dental, preveterinary sciences
Biology, general
Zoology, general
Anatomy and Histology
Bacteriology, Virology, Mycology, Parasitology
Biochemistry
Biophysics
Entomology
Genetics (including experimental plant and animal breeding)
Optometry (preprofessional bachelor's degree)
Pathology (excluding Plant Pathology)
Pharmacology (excluding Pharmacy)
Physiology (excluding Plant Physiology)
Plant Pathology
Plant Physiology
Biological sciences, all other

* Footnotes follow on p. 44.

Business and Commerce b/

Accounting
Hotel and Restaurant Administration
Secretarial Studies
Business and Commerce, other specific major fields
Business and Commerce, general (general curriculum
without major specialization)
Business and Commerce -- not further classified

Education

Specialized Teaching Fields

Physical Education (separate curriculum or combined
curriculum with Health Education or Recreation)
Health Education (separate curriculum)
Recreation (separate curriculum)
Education of Exceptional Children (all areas except
Education of Mentally Retarded and Speech Correction)
Education of Mentally Retarded
Speech Correction
Agricultural Education
Art Education
Business Education, Commercial Education
Distributive Education (retail selling)
Home Economics Education
Industrial Arts Education (nonvocational)
Music Education
Trade and Industrial Education (vocational)
Specialized teaching fields, all other

General Teaching Fields

Nursery and/or Kindergarten Education
Early Childhood Education (through primary grades)
Elementary Education
Secondary Education (including junior high school) d/
Combined Elementary and Secondary Education
Adult Education
Other

Nonteaching Fields

Counseling and Guidance, Educational, Administration
and Supervision, Educational Finance, Curriculum,
Comparative Education, and so on
Education, general (without specific concentration) --
second-level or higher degrees only
Other

Education -- Preprofessional bachelor's degree only

Education -- not further classified

Engineering

Aeronautical Engineering
Agricultural Engineering
Architectural Engineering
Ceramic Engineering
Chemical Engineering
Civil Engineering
Electrical Engineering
Engineering Mechanics
Engineering Physics
Engineering Science
General Engineering e/
Geological Engineering
Geophysical Engineering
Industrial Engineering f/
Mechanical Engineering
Metallurgical Engineering
Mining Engineering
Naval Architecture and Marine Engineering
Petroleum Engineering
Sanitary Engineering
Textile Engineering
Welding Engineering
Unclassified
Other g/

English and Journalism

English Language and Literature (including Comparative Literature)
Journalism

Fine and Applied Arts b/

Art, general (general curriculum without major specialization)
Music, including Sacred Music (excluding Music Education)
Speech and Dramatic Arts (excluding Speech Correction)
Fine and Applied Arts, other specific major fields
Fine and Applied Arts -- not further classified

Foreign Languages and Literature

Linguistics (including Phonetics and Semantics)
Latin and/or Greek

Modern Foreign Languages

Chinese
French
German
Italian
Japanese
Philology and Literature of Germanic Languages
Philology and Literature of Romance Languages
Russian or other Slavic Languages
Spanish
Modern foreign languages, all other
Foreign languages and literature, not classifiable above

Forestry

Geography

Health Professions c/

Chiropody or Podiatry
Dental Hygiene
Dentistry (D.D.S. and D.M.D. only)
Hospital Administration
Medical Technology
Medicine (M.D. only)
Nursing (including Public Health Nursing; excluding Nursing Education)
Occupational Therapy
Optometry (excluding preprofessional degree)
Osteopathy
Pharmacy (excluding Pharmacology)
Physical Therapy, Physiotherapy
Public Health

Health Professions c/ (Continued)

Radiologic Technology (mainly X-Ray technique)
Veterinary Medicine (D.V.M. only)
Clinical dental sciences (advanced degrees only)
Clinical medical sciences (advanced degrees only)
Clinical veterinary medical sciences (advanced degrees only)
Health professions, all other

Home Economics b/

Home Economics, general curriculum
Child Development, Family Relations
Clothing and Textiles
Foods and Nutrition
Institution Management, Institution Administration
Home Economics, other specific major fields
Home Economics -- not further classified

Law (LL.B., J.D., or higher degree)

Library Science

Mathematical Subjects

Mathematics
Statistics (including Actuarial Science)

Merchant Marine -- Deck-Officer Curriculum Only

Military, Naval, or Air Force Science

Philosophy

Philosophy (except Scholastic Philosophy)
Scholastic Philosophy

Physical Sciences h/

Physical Science, general (without specific major)
Astronomy
Chemistry (excluding Biochemistry)
Metallurgy (excluding Metallurgical Engineering)
Meteorology
Physics

Earth Sciences

Geology
Geophysics (including Seismology)
Oceanography
Earth sciences, all other

Physical sciences, not classifiable above

Psychology

Religion

Religious Education and Bible
Theology (curriculum leading specifically to first-
professional ministerial degree)
Theology (master's and doctor's degrees only)
Religion (liberal arts curriculum, nonsectarian)
Religion, all other

Social Sciences i/

Basic i/

Social Science, general (without specific major)
American Civilization, American Culture
Anthropology
Area studies, regional studies
Economics (excluding Agricultural Economics)
History
International Relations
Political Science or Government
Sociology
Basic social sciences, all other

Applied

Agricultural Economics
Foreign Service Program (consular and diplomatic service)
Industrial Relations
Public Administration
Social Work, Social Administration
Applied social sciences, all other

Trade and Industrial Training b/

Miscellaneous

Arts, general program (without major field)
Sciences, general program (without major field)
Arts and Sciences, general program
Major fields of study not classifiable above
Major field not identified

II. Specialties in Higher Educational Institutions of the USSR j/

Engineering

Geology and the Exploration of Mineral Deposits

Geology and exploration of mineral deposits
Geological surveying and prospecting for mineral deposits
Geology and prospecting for oil and gas deposits
Prospecting and preparing peat deposits for exploitation
Geophysical methods of search and prospecting for mineral deposits
Geochemistry
Hydrogeology and engineering geology
Techniques of prospecting for mineral deposits
Geology

Exploitation of Mineral Deposits

Mine surveying
Exploiting mineral deposits
Exploiting peat deposits
Concentration of minerals
Exploiting oil and gas deposits
Constructing mining enterprises
Design and operation of gas pipelines, gas storage tanks,
and petroleum sites
Installation of gas pipelines, gas storage tanks,
and petroleum sites

Power Engineering

Electric stations and systems
Electric networks
Electrification of industrial enterprises
and establishments
Mining electromechanics

Power Engineering (Continued)

Thermal power establishments of electric power stations
Hydroelectric power establishments
Industrial thermal power
Thermal physics
Design and operation of atomic energy installations

Metallurgy

Metallurgy of ferrous metals
Metallurgy of nonferrous metals
Metallurgical furnaces
Foundry production of ferrous and nonferrous metals
Physico-chemical research of metallurgical processes
Physics of metals
Science of metals; equipment and technology of thermal processing of metals
Processing of metals by pressure

Machine Building and Instrument Construction

Technology of machine building, metal cutters, and instruments
Machines and technology of foundry production
Machines and technology of processing metals by pressure
Equipment and technology of welding production
Mechanical equipment of plants of ferrous and nonferrous metallurgy
Mining machines
Peat machines
Machines and equipment of oil and gas products
Agricultural machines
Hoisting and transport machines and equipment
Construction and road machines and equipment
Railroad car construction
Motor vehicles and tractors
Shipbuilding and repair
Polygraphic machines
Machines and apparatus of chemical production
Machines and apparatus of food production
Machines and apparatus of light and textile industry production
Machines and mechanisms of the timber industry and forestry
Boiler construction
Turbine construction
Machines and equipment for communications enterprises
Internal combustion engines

Machine Building and Instrument Construction (Continued)

Ship machines and mechanisms
Ship power installations
Locomotive building
Dynamics and strength of machines
Hydraulic turbines and other hydraulic machines
Refrigerating and compressor machines and installations
Optical instruments
Instruments of precision mechanics
Mechanical equipment of aircraft
Film apparatus
Aircraft construction
Aviation motive power
Gyro-aerodynamics
Optics and spectrosopes
Optical-physical instruments

Electrical Machine Building and Electrical Instrument Building

Electrical machines and apparatus
Electrical transport
Electrical insulation and cable technics
Dielectrics and semiconductors
Electrovacuum machines
Automechanics and telemechanics
Automation of productive processes
Mathematical and calculating instruments and installations
Gyrosopic instruments and installations
Electro-acoustics and ultrasonic engineering
Electronic instruments
Industrial electronics
Electrothermic installations
Lighting engineering and lighting sources
Sound engineering
Aircraft appliance construction
Electrical equipment of ships
Technical operation of aircraft instruments and electrical
equipment of aircraft
Electromechanical apparatus of communications
Instruments and installations of radiometric and dosimetric
measurement
Electromasurement technology
Electronic-medical apparatus

Radio Engineering and Communications

Radio engineering
Telegraph and telephone communications
Radio communications and radiobroadcasting
Design and technology and production of radio apparatus
Radiophysics and electronics
Technical operation of aircraft radio equipment

Chemical Technology

Technology of oil and gas
Chemical technology of fuel
Technology of inorganic substances
Technology of rare and scattered elements
Technology of electrochemical production
Technology of silicates
Technology of basic and organic synthesis and synthetic rubber
Technology of dyes and intermediate products
Technology of medicinal and aromatic substances
Technology of plastics
Technology of lacquers, paints, and nonmetallic coverings
Technology of rubber
Technology of cinematographic materials
Technology of electrovacuum materials
Chemical kinetics and combustion
Technology of separation and application of isotopes
Chemical engineering
Radiational chemistry

Timber Engineering and Technology of Wood, Cellulose, and Paper

Timber engineering
Mechanical technology of wood
Chemical technology of wood
Technology of cellulose and paper production

Technology of the Food Products Industry

Storage and technology of processing grain
Technology of bread, pasta, and pastry production
Technology of sugars
Technology of fermentation
Technology of wine making
Technology of vegetable fats
Technology of canning
Technology of subtropical crops

Technology of the Food Products Industry (Continued)

Technology of meat and milk products
Technology of fish products
Technology and organization of public feeding
Industrial fishing
Ichthyology and pisciculture
Technology of food products
Technology of vitamin production

Technology of Consumer Goods

Initial processing of fibrous materials
Mechanical technology of fibrous materials
Chemical technology of fibrous materials
Technology of artificial leather
Technology of leather goods
Technology of polygraphic production
Technology of apparel and footwear production

Construction

Architecture
Industrial and civil construction
Hydrotechnical construction of river installations
and hydroelectric power stations
Hydrotechnical construction of sea lanes and ports
Urban construction and urban economy
Production of concrete and reinforced concrete and parts
for precast construction
Gas-heat supply and ventilation
Water supply and piping
Railroad construction
Highways
Bridges and tunnels
Construction of airports
Hydrotechnical and hydromeliorative construction
Sanitary technology
Construction of roads, bridges, and airports

Geodesy and Cartography

Engineering geodesy
Astronomic geodesy
Aerial photogeodesy
Cartography

Hydrology and Meteorology

Hydrology of land
Oceanology
Hydrography
Meteorology
Agrometeorology

Agricultural Technology

Organization of agricultural production
Mechanization of the processes of agricultural production
Electrification of the processes of agricultural production
Hydromelioration

Transportation

Rolling stock and tractive economy of railroad transportation
Electrification of railroad transportation
Automation, telemechanics, and communications in railroad transportation
Operation of railroads
City electric transportation
Ship navigation on sea routes
Ship navigation on internal water routes
Operation of water transportation
Operation of motor vehicle transportation
Operation of aircraft and engines

Agriculture and Forestry

Science of soils and agrochemistry
Agronomy
Fruit and vegetable growing and viticulture
Plant protection
Silk growing
Zootechnics
Veterinary medicine
Forestry

Economics

Planning of the national economy
Economics of industry
Economics and planning of material and technical supply
Economics of labor
Economics and organization of the mining industry

Economics (Continued)

Economics and organization of the oil and gas industry
Economics and organization of power
Economics and organization of the metallurgy industry
Economics and organization of the machine building industry
Economics and organization of the shipbuilding industry
Economics and organization of the chemical industry
Economics and organization of the polygraphic industry
Economics of cinematography
Economics and organization of the consumer goods industry
Economics and organization of agriculture
Economics of agriculture
Economics and organization of the food products industry
Economics and organization of the timber industry
Economics and organization of the wood-processing and cellulose
and paper industries
Economics and organization of construction
Economics and organization of the urban economy
Economics and organization of railroad transportation
Economics and organization of water transportation
Economics and organization of motor vehicle transportation
Economics and organization of air transportation
Economics and organization of communications
Economics of trade
International economic relations
Merchandising industrial commodities
Merchandising food products
Finance and credit
Statistics
Accounting
Mechanization of accounting and record keeping
Economics of the national economy

Law

Jurisprudence
International relations

Health and Physical Culture

Medicine
Pediatrics
Sanitation
Stomatology (oral medicine)
Pharmacy
Physical culture and sports

Specialties in Universities (except engineering, agriculture,
economics, law, and medicine)

Russian language and literature
Native languages and literature of the peoples of the USSR
Slavic languages and literature
Romance and Germanic language and literature
Eastern languages and literature
Classic philology
Study of countries in the East
History
Science of history and archives
Political economy
Philosophy
Psychology
Mathematics
Mechanics
Astronomy
Physics
Geophysics
Chemistry
Biology
Botany
Zoology
Physiology of plants
Physiology of man and animals
Anthropology
Journalism
Literature
History of the arts
Geography

Specialties in Pedagogical and Library Institutes

Russian language and literature
Native language and literature of the peoples of the USSR
Foreign languages
Mathematics
Physics
Natural science and chemistry
Geography
History
Drafting and drawing
Pedagogy and psychology
Defectology
Cultural education
Library science and bibliography

Specialties in Pedagogical and Library Institutes (Continued)

Physical education
Native language and literature (in 2-year teachers institutes)
Physics and mathematics (in 2-year teachers institutes)
History (in 2-year teachers institutes)
Natural science and geography (in 2-year teachers institutes)
Music and singing
General-technical discipline and labor
Pedagogy and methodology of national education

Art

Pianoforte (organ)
Orchestral instruments
Folk instruments
Singing
Opera and symphony direction
Choral direction
Composition
Science of music
Actor of dramatic theater and cinema
Actor of musical comedy
Direction of drama
Direction of musical theater
Direction of ballet
Cinema director
Movie equipment operator
Theater technics and staging
Science of theater
Science of cinema
Painting
Graphics
Sculpture
Artistic working of metal
Artistic working of wood
Artistic working of glass and plastics
Artistic ceramics
Artistic design of fabrics
History and theory of fine arts
Interior decorating

- a. 57/
- b. Students who have prepared to teach in the following specialized fields are included under "Education": Agricultural Education, Art Education, Business Education and Commerce, Distributive Education (retail selling), Home Economics Education, Industrial Arts Education (nonvocational), Music Education, Speech Correction, and Trade and Industrial Education (vocational).
- c. Not including Psychology, which, because of its multicategory nature, has been listed independently.
- d. Including degrees based on secondary education as the major field of study. Degrees based on a teaching major in a particular subject-field, such as English, biology, physical sciences, business education, and the like, are classified as degrees in English, biology, and so on, and not as degrees in Secondary Education.
- e. Including also the separately accredited curriculum, "Engineering," at the University of California (Los Angeles) and at the Stevens Institute of Technology (as distinguished from "General Engineering").
- f. Including administrative engineering, management engineering, and so on.
- g. All curricula accredited before 1959 by the ECPD (Engineers' Council for Professional Development) in one or more institutions are listed by specific title; curricula which were not then accredited by the ECPD at any institution are included under "Other."
- h. Not including Geography, which, because of its multicategory nature, has been listed independently.
- i. Not including Geography, Philosophy, or Psychology, which, because of their multicategory or comprehensive nature, have been listed independently, in alphabetical order.
- j. 58/. Certain agricultural fields are included under "Engineering" in accordance with the classification system indicated in source 59/.

APPENDIX D

SOURCE REFERENCES

1. Health, Education and Welfare, Office of Education. Engineering Enrollments and Degrees, 1960, circ no 638, 1961, p. 14.
USSR, Central Statistical Administration. SSSR v tsifrakh v 1960 godu (The USSR in Figures in 1960), Moscow, 1961, p. 314.
2. Health, Education and Welfare, Office of Education. Engineering Enrollments and Degrees, 1960, circ no 638, p. 10.
USSR, Central Statistical Administration. Narodnoye khozyaystvo SSSR v 1959 godu (National Economy of the USSR in 1959), Moscow, 1960, p. 746. (hereafter referred to as Narodnoye 1959)
USSR, Central Statistical Administration. Narodnoye khozyaystvo SSSR v 1960 godu (National Economy of the USSR in 1960), Moscow, 1961, p. 773. (hereafter referred to as Narodnoye 1960)
3. Labor, Bureau of Labor Statistics. The Long-Range Demand for Scientific and Technical Personnel, prepared for the National Science Foundation, NSF 61-65, 1961, p. 33. (hereafter referred to as Long-Range Demand)
4. Commerce, Bureau of the Census. Educational Attainment: March 1962, ser P-20, no 121, 7 Feb 63, p. 1.
USSR, Central Statistical Administration. Sredneye spetsial'noye obrazovaniye v SSSR, statisticheskiy sbornik (Secondary Specialized Education in the USSR, A Statistical Handbook), Moscow, 1962, p. 15.
5. Pravda, 15 Jan 60.
6. Commerce, Bureau of the Census. Statistical Abstract of the United States, 1961, 1961, p. 239.
7. DeWitt, Nicholas. Education and Professional Employment in the USSR, National Science Foundation, 1961, p. 453.
8. USSR, Central Statistical Administration. Vyssheye obrazovaniye v SSSR (Higher Education in the USSR), Moscow, 1961, p. 62-65. (hereafter referred to as Vyssheye)
9. DeWitt, op. cit. (7, above).
10. Engineers Joint Council. The Training, Placement and Utilization of Engineers and Technicians in the Soviet Union, New York, 1961, p. 12.
11. DeWitt, op. cit. (7, above).
12. Labor, Bureau of Labor Statistics. Occupational Outlook Handbook, 1961 Edition, bulletin no 1300, p. 78.
13. USSR, Central Statistical Administration. Zdravookhraneniye v SSSR (Health in the USSR), Moscow, 1960, p. 84.

14. Granick, David. The Red Executive, New York, 1960, p. 63-73.
"1,700 Top Executives," Fortune, Nov 59, p. 138 ff.
15. Wolfle, Dael. America's Resources of Specialized Talent,
New York, 1954, p. 212 ff.
16. DeWitt, op. cit. (7, above), p. 437 ff.
17. "1,700 Top Executives," Fortune, Nov 59, p. 138 ff.
18. Congressional Quarterly Almanac, 86th Congress, 2d Session,
1960, Vol. XVI, Washington, 1960, p. 33-35.
19. Wolfle, op. cit. (15, above), p. 61.
20. Ibid., p. 52.
21. DeWitt, op. cit. (7, above), p. 360-363.
22. Labor, Bureau of Labor Statistics. Special Labor Force
Reports, No. 1, "Educational Attainment of Workers, 1959,"
Feb 60, p. A-12.
23. Vyssheye (8, above), p. 54.
24. Granick, op. cit. (14, above), p. 62.
25. Vestnik svyazi, no 7, Jul 60, p. 15-17.
26. USSR, State All-Union Scientific Research Institute for the
Cement Industry. Rezervy tsementnoy promyshlennosti SSSR
(Reserves of the Soviet Cement Industry), Moscow, 1959,
p. 128.
27. Ekonomicheskaya gazeta, 21 Jul 62, p. 2.
28. Narodnoye 1960 (2, above), p. 33-35.
USSR, Central Statistical Administration. Zhenshchiny i deti
v SSSR (Women and Children in the USSR), Moscow, 1961,
p. 107-112.
29. USSR, Central Statistical Administration. Sistemicheskiy
slovar' zanyatiy (Systematic Dictionary of Occupations),
Moscow, 1959.
30. USSR, Central Statistical Administration. Sel'skoye khozyaystvo
SSSR (Agriculture in the USSR), Moscow, 1960, p. 470.
31. Long-Range Demand (3, above), p. 61.
32. Narodnoye 1960 (2, above), p. 33.
33. USSR, Central Statistical Administration. Sistemicheskiy
slovar' zanyatiy (Systematic Dictionary of Occupations),
Moscow, 1959, p. 28-31.
34. US House of Representatives, 86th Congress, 2d Session.
Hearings Before the Subcommittee of the Committee on Appropriations,
"Comparison of United States and USSR Science Education,"
1960, p. 35.
35. USSR, Central Statistical Administration. SSSR v tsifrakh v
1960 godu (The USSR in Figures in 1960), Moscow, 1961, p. 314.
36. Commerce, Bureau of the Census. Literacy and Educational
Attainment: March 1959, ser P-20, no 99, 4 Feb 60.
37. DeWitt, op. cit. (7, above), p. 31.
38. Commerce, Bureau of the Census. Literacy and Educational
Attainment: March 1959, ser P-20, no 99, 4 Feb 60, p. 13.

39. Defense. Selected Manpower Statistics, Feb 62, p. 43.
40. Ibid., 29 Jan 60, p. 29.
41. Labor, Bureau of Labor Statistics. Special Labor Force Reports, no 1, "Educational Attainment of Workers, 1959," Feb 60, p. A-6.
42. Vyssheye (8, above), p. 29.
43. Narodnoye 1959 (2, above), p. 602.
44. USSR, Central Statistical Administration. Zhenshchina v SSSR (Woman in the USSR), Moscow, 1960, p. 57.
45. Narodnoye 1959 (2, above), p. 615.
46. Wolfle, op. cit. (15, above), p. 294-295.
47. Health, Education and Welfare, Office of Education. Earned Degrees Conferred by Higher Educational Institutions, annual issues, 1954-58.
48. Wolfle, op. cit. (15, above), p. 303-307.
49. Narodnoye 1959 (2, above), p. 604.
50. Vyssheye (8, above), p. 52, 64.
51. Ibid.
52. DeWitt, op. cit. (7, above), p. 453.
53. Long-Range Demand (3, above), p. 48, 61.
54. Commerce, Bureau of the Census. US Census of Population: 1960, final report, PC (1) - 1C, 1962, p. 216.
55. Ibid., Classified Index of Occupations and Industries, 1960, p. 9-12.
56. Long-Range Demand (3, above), p. 32.
57. Health, Education and Welfare, Office of Education. Earned Degrees Conferred, 1958-59, Washington, 1961, p. 31-35.
Ibid., Engineering Enrollments and Degrees, 1959, Washington, 1960, p. 24.
58. Komarov, L.A. Planirovaniye podgotovki i raspredeleniya spetsialistov v SSSR (Planning the Training and Distribution of Specialists in the USSR), Moscow, 1961, p. 82-92.
59. Vyssheye (8, above), p. 55, 62-65.