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EXTERNAL RESEARCH INTELLIGENCE STUDY

SOVIET EDUCATION IN GEODESY AND CARTOGRAPHY



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A PROVISIONAL REPORT



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CENTRAL INTELLIGENCE AGENCY  
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FOREWORD

This report is one of a series prepared for an external research project entitled "The Problem of Soviet Capabilities in Geodesy and Cartography," which was sponsored by the CIA as an element of the research program of the Geography Division, Office of Research and Reports. [REDACTED]

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Inadequate knowledge concerning the status of Soviet developments in geodesy, photogrammetry, and cartography has been recognized as an intelligence deficiency, and intelligence reports in these fields are extremely few in number and limited in topical coverage. For these reasons, the project was initiated to assess Soviet capabilities on the basis of a systematic study of all available published information on Soviet developments in geodesy, geodetic gravimetry, geodetic astronomy, geodetic and photogrammetric instrumentation, and cartography. The resulting reports are derived almost entirely from an exhaustive search for and an analysis of published Soviet scientific source materials.

The reports of the project are designed not only to provide provisional information on the current status of Soviet capabilities in surveying and mapping [REDACTED]

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[REDACTED] The opinions and conclusions presented in ER-11, therefore, do not represent final CIA evaluation of Soviet capabilities in surveying and mapping. Comments by users of the reports are solicited by the Geography Division.

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This report provides a survey of Soviet education in geodesy and cartography. The report is arranged in three parts. Part I gives a brief summary of the essentials of Soviet education and training in general as a background for the detailed description of geodetic and cartographic instruction, educational facilities, and training programs in Part II. Part III discusses research institutes for geodesy and cartography, most of which also provide education and training in these fields.

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CONCLUSIONS

1. The status of Soviet training and research in the fields of geodesy and cartography ought to be considered in a historical perspective. It is not the status of the Soviets in these fields in 1953 that is significant but the rate of progress from almost absolute zero in 1920 to a very large and elaborate structure in 1953 that surprises and impresses an unprejudiced investigator.

2. The outstanding feature of Soviet organization of research and training in our field of interest is the perpetual changes by no means restricted to the early period of Soviet reorganization of the country. It was found, for instance, that instruction in geography and cartography in universities underwent drastic changes in the period between 1950 and 1952. In view of lack of continuity of the record, and especially in view of paucity of information relating to the period after the war, most of our conclusions refer to the years 1945-46.

3. The Soviets evidently experienced lack of competent ordinary workers and some drastic moves were made to train such workers in the system FZO. Professional papers in geodesy and cartography are full of complaints on this score. Instructions for workers in field work and cartographic factories are extremely detailed and presuppose a very low technical level of workers. The Soviets are evidently aware of this situation and are trying their best to improve it.

4. In the intermediate training in geodesy and cartography, the Soviets by 1948 had nine topographic technicums and one school of aerial survey. The programs for these institutions have been found to be on a rather high level

and in professional subjects these technicians should be considered as fully equivalent to the first two years of American universities. The enrollment in these schools in 1948 was about 2,000 students, and it is estimated that the Soviets by now should have at least 10,000 technicians available.

5. The highest level of training in geodesy and cartography is given in two specialized institutes, one in Moscow and the other in Novosibirsk. The program of instruction for the Moscow Institute of Engineers of Geodesy, Aerial Survey and Cartography was considered in detail and was found to be on the highest level. The existence of this institute alone with an annual enrollment of over 400 students would make the Soviets exceptionally strong in specialists in geodesy and cartography.

In addition to the Moscow institute and the smaller one in Novosibirsk the training of geodesists and cartographers is given in the Military Engineering Academy, in 27 universities (mostly geographers) as well as in a few other specialized schools. It is estimated that by 1953 the Soviets should have 10,000 highly trained specialists in geodesy, aerial survey and cartography, of which the Moscow institute alone accounts for 6,000.

The emphasis put by the Soviets on the continuation of training after graduation is also noteworthy. The engineers in production are not allowed to become committed to familiar methods and apparently are forced in some way to take refresher courses and become acquainted with new developments in their specialties. The large number of engineers taking these refresher courses (700 in 1938 in the Moscow institute alone) indicates either direct compulsion or some benefits in advancement in their service. At any rate it is clear that the Soviet government expects their engineers to be fully abreast of the newest developments in their profession.



The conclusion seems inescapable that the Soviets have the best training system in geodesy and cartography in the World. As for the large number of highly trained specialists in these subjects there cannot be any doubt and it is possible that the Soviets produce more of them than the rest of the World put together. As for the quality of these experts, the conclusion is less certain. The instruction programs, published textbooks and the amount and character of research published by the Soviets along these lines definitely indicate a level of training fully comparable to that in Western schools.

6. Research in the U.S.S.R. in geodesy and cartography is carried on in all institutions already mentioned. In fact considerable emphasis is on the desirability and necessity of research by instructors whose primary duty is teaching. However, by way of research the Soviets have a large institution wholly devoted to this problem. This is the Central Research Institute of Geodesy, Aerial Survey and Cartography in Moscow (TsNIIGAIK). As early as 1935 there were 172 persons on the scientific staff of this institute. No later figure is available but one may expect a considerably larger staff at the present time.

Some research on specialized problems of geodesy and cartography is done in other research institutes, of which the Research Institute of Military Topographic Service should be especially mentioned.

The evaluation of Soviet research is done in other reports on specific problems of geodesy and cartography. A few general features of Soviet research may be mentioned here:

- (a) A very large volume of research. It is evident that a comparatively small fraction of openly published Soviet research papers and books ever reaches this country. There must be also a considerable

amount of classified research, of which we know almost nothing. There can be little doubt that in the bulk of research on the problems of geodesy and cartography, the U.S.S.R. exceeds any other country, and perhaps even all other countries combined.

- (b) The quality of research is difficult to estimate, owing to conspicuous gaps in our information. One is impressed with the amount of attention paid by the Soviets to comparatively trivial subjects. However, there is much excellent work being done in the U.S.S.R., of which the determination of the reference ellipsoid, (Krasovskiy and Izotov), and application of gravimetry to geodetic problems, (Molodenskiy, Zhongolovich and Zagrebin), should be mentioned. Such work requires participation of many persons. Since it is by its nature very expensive, this indicates the realization of its importance by the Soviet government.
- (c) The Soviet writers invariably display a very thorough and up-to-date acquaintance with results obtained in their field of effort in the West. Many articles and whole books have been published in the U.S.S.R. on the state of geodesy and cartography in foreign countries, including the U.S.A.
- (d) There seems to be very little political interference in research so far as geodesy and cartography is concerned.

7. The conclusion is that the Soviets have a very much better organization of training and research in geodesy and cartography than any other nation in the World. They are now nearly, if not quite, the leaders in the World in such branches of geodesy and cartography as gravimetric geodesy and

and mathematical cartography. The situation is less clear in photogrammetry and especially radiolocation, but it has been established that the Soviets pay great attention to these subjects.

In other words, the Soviets have the capability to forge ahead of the rest of the World in the general subjects of geodesy and cartography. Whether this will actually happen will depend on two factors which could not be considered in the present report:

- (a) Whether the Soviets will succeed in raising the cultural, scientific and technical level of the whole population to keep up with the striking development of training on the higher level and of research.
- (b) Whether research and training will be spared serious political interference.

GENERAL INTRODUCTION

Adequate analysis and evaluation of any aspect of both the Soviet scientific actuality and potential must be prefaced by as complete a comprehension of the basic fundamentals of Soviet life, philosophy, mores, and history as is humanly possible. Many investigators have already become aware of the extreme complexity of Soviet science and industry and the many difficulties attendant to the problem of solving the Soviet riddle. Perhaps the greatest obstacle, however, encountered by all American scientists and technicians is a lack of appreciation or knowledge of certain more or less intangible or little understood factors which are integral parts of Soviet development in all fields. Of vital and urgent importance are the answers to such questions as, - "How is it possible that the Soviets have been able to develop the 'A' bomb so rapidly?", "How is it possible that Soviet technology and industry have produced the MIG-15?" - and more specifically related to our present field of investigation, - "What conditions made the extensive mapping and geodetic programs of the U.S.S.R. during the past twenty years possible?". The answers to these and similar questions being asked by many intelligence, scientific, research and development groups in this country invariably are to be found, in whole or in part, in these so-called "intangible" factors.

Time, space, or scope of this project - or knowledge of or research by the staff of this project for that matter - do not permit exhaustive description of these intangibles. Indeed, except in so far as they specifically relate to the more or less definite problems of analysis of Soviet scientific achievements in geodesy, photogrammetry and cartography or in the technological phases of development in these fields, no report can be made on them at this time.

A thorough knowledge of the educational and training programs of the U.S.S.R. is absolutely essential for complete and accurate evaluation of Soviet science or industry potential. A tendency to compare numerical statistics - U.S. ton to U.S.S.R. ton, U.S. ships or planes to U.S.S.R. ships or planes - has been carried over into the scientific field too often by some analysts. Such analyses fail to take account of the underlying significance of Soviet programs in the educational and training fields or to realize what has been and is still being accomplished in the matter of developing scientists and technicians in many fields. That geodetic or cartographic knowledge and "know how" in the United States equals or exceeds that of the U.S.S.R. may be a true statement. However, this fact, by itself, would be a most dangerous one on which to base our own future geodetic and cartographic programs, smug in the belief that ours is a superior ability. The really significant part involves the answers to such questions as, "Will the Soviets produce scientists capable of not only equalling the work of scientists of other nations, but who can also make those original contributions on which the further development of science and technology depend?" "How many scientists and technicians are being graduated in each field per year" "What are their educational and training requirements as compared with ours?" "What is the quality of their work?" "How many schools teach these subjects?" "What are the Soviet plans for future programs and what fields of science and technology are being emphasized, and why?".

The following report, data for which was obtained from open source material only, is an attempt to answer, at least in part, some of these questions as they pertain to the problem of evaluating and defining the Soviet potential in the fields of geodesy and cartography.

SOURCES

Experience gained by the staff of this Laboratory during the last five years has indicated that certain general conditions always obtain in all phases of the study of Soviet science and technology. These conditions

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are sufficiently well-known now that exhaustive treatment and descriptions are unnecessary for the purpose of this report. Major items, however, may be stated briefly, as follows:

1. Difficulties encountered in the collection of Soviet data.
  - a. Incompleteness of U.S. library holdings of Soviet scientific books, serials, periodicals, etc.
  - b. Lack of consistent library cataloging procedures.
  - c. Lack of competent personnel, - translators, abstracters, or scientists who read the Russian language.
  - d. High security classifications attached to several projects and materials dealing with the various phases of the Soviet problem have resulted, perhaps necessarily, in further complicating the collection of basic material.
2. Difficulties caused by the Soviet modus operandi.
  - a. Lack of competent editing in Soviet publications.
  - b. Existence of Soviet decrees pertaining to the dissemination of their scientific data.
  - c. Frequent changes in names and character of research educational and production facilities, involving publications.

- d. Changes in scientific or scientific-political emphasis in the Soviet Union.
- e. Difference between United States and Russian definition of "Science" (Nauka) and associated differences in classifications of sciences, educational and research programs.

Items (a) and (b) apply to all scientific effort in the Soviet Union. Items (c) and (e) also always apply but, of course, vary considerably in detail with the particular sciences under investigation.

3. Difficulty in distinguishing between and categorizing research, training, and industrial facilities, along with associated personnel and publications.

Tedious and painstaking work over an extended period by many hundreds of individuals, both here and abroad has resulted in the collection of a considerable amount of information on various aspects of Soviet science. Various groups and agencies have prepared partial or complete translations and abstracts. This report will attempt to correlate and digest all open-source materials made available  or discovered by its own staff, which pertain to the fundamental problem of scientific education and training in the Soviet Union with specific emphasis on educational programs in the fields of geodesy and cartography.

Perhaps one of the most obvious and consistently representative statements that can be made concerning the availability of scientific source materials is that, prior to the year 1941, detailed information of both a theoretical and specific nature was available to all those who sought and read it. Publications of nearly all types could be had for the asking. From reports of this period (1919-1940 inclusive) a rather complete history

of the development of theoretical and applied science and educational programs, curricula, etc. can be reconstructed. After 1940 (1941-1947) there followed a period in which Soviet science went through considerable political and scientific change, new programs resulted from war experiences and sciences not previously supported by the government received new impetus. Some curtailment in the amount of scientific and educational work resulted, although not to the extent that might have been expected as a result of occupation, destruction and re-location. During this period, publications of a scientific nature, though still available to this country, were not obtained in as great abundance here and those that were available were of a less specific and comprehensive nature.

The most serious hiatus, however, resulted from the Russian ban on the export of all scientific data affecting defense in 1947. From this time to the present, specific scientific data are almost entirely lacking. That information which has been obtained by us is of a general or theoretical nature, and is fragmentary and often contradictory or otherwise confusing. Additional data published between 1941 and the present continue to trickle into this country. As more and more of this information becomes available, some of the uncertainties mentioned in this report may perhaps be removed.

For the period prior to 1941 the best source of information on geodetic and cartographic programs and methods is the Russian professional journal, "Geodezist", which contains many articles on the subject of training and research as well as the chronicle of events in the system of the Main Administration of Geodesy and Cartography (Glavnoye Upravleniye Geodezii i Kartografii and denoted as GUGK henceforth in this report). The military counterpart of the GUGK, the Military Topographic Administration (Voyenno-Topograficheskoye Upravleniye, VTU) also participated in the publication



of the "Geodezist," although even before the war very little was being published on the activity of the VTU in the "Geodezist" or elsewhere. In December 1940 this journal was discontinued and was supplanted by the "Sbornik Nauchno-Tekhnicheskikh i Proizvodstvennykh Statey po Geodezii, Kartografii, Aeros"yemke i Gravimetrii" (Collection of Scientific, Technical and Production Articles on Geodesy, Cartography, Aerial Survey and Gravimetry, henceforth as Sbornik NTPS) published by the GUGK alone. Simultaneously the VTU began publishing its own Sbornik (Voyenno-Topograficheskiy Sbornik). No definite statement has been found to date as to the reasons for this change. However, so far as we are concerned, the change was for the worse since articles are much less detailed and the chronicle of events is almost absent.

Another valuable source of information for the period up to 1940 is the two-volume work, "XX Let Sovetskoy Geodezii i Kartografii," (20 Years of Soviet Geodesy and Cartography) published in 1939 in which detailed reviews of various branches of geodesy and cartography are given.

After 1940 we must rely on the less comprehensive information published in the Sbornik NTPS as well as information found in reference books, textbooks, encyclopedias, miscellaneous periodicals, monographs, etc., to which reference is given in the text of this report.

#### I. EDUCATION AND TRAINING IN GENERAL

Training in geodesy and cartography is part and parcel of the comprehensive Soviet system of training and it is necessary before we treat the specific problems of geodesy and cartography to say something about the system as a whole. The purpose of this section is to provide a general background to readers not acquainted with the Soviet educational system. It is, therefore, not to be construed as a definitive study of the Soviet system as a whole.

The central theme of Soviet education has always been the "kadry". The importance of the "kadry", (that is, cadres) scientific and technical personnel, was realized by Lenin immediately after he assumed power. Imperial Russia was relatively poor in scientific and technical personnel. Moreover, much of the existing pre-revolution personnel was opposed to the Communistic government and therefore was either annihilated or driven abroad. Lack of suitable personnel made speedy recovery and industrialization of the country after the ravages of World War I and the revolution very difficult. In fact, it appears that only the liberal employment of foreign engineers and technicians saved the situation. However, the Soviet government clearly realized that it could not depend forever on foreign help and very consistently carried forth a program of providing the country with native expert personnel. A most striking expression of this attitude was given by Stalin in his report to the 17-th Congress of the Communistic Party, January 26, 1934. Speaking of the development of Soviet industry the preceding three years, he said:

"But of all achievements of industry during the period covered by this report we must count as the most important achievement our success in educating and training thousands of new workers and new leaders of industry. We have produced a whole new generation of engineers and technicians and hundreds of thousands of qualified workers who have mastered the new technology and advanced our socialistic industry. There is no doubt that without these people our industry could not achieve the results of which we are so proud. We have the data to show that during this period factory and mill schools produced 800,000 more or less qualified workers, and universities, technological schools and technicums graduated more than 180,000 engineers and technicians. If it is true that the problem of the cadres is the most ser-

ious problem of our development, we must admit that our industry is beginning to solve this problem."

This is not a chance quotation from Stalin. One can collect dozens of similar quotations from his speeches, as well as from speeches of other leaders of the U.S.S.R. With such an attitude prevalent in the ruling circles, rank and file educators took up the theme and published innumerable books on general and technical education in which the experience of other countries was analyzed, criticized and compared with the U.S.S.R. experience. There were (and perhaps still are) several periodicals specifically devoted to the problem of the cadres, such as "Za Promyshlennyye Kadry" (For industrial Cadres), "Kadry Sovetskoy Promyshlennosti" (Cadres of Soviet Industry), etc.

The general features of the scientific and technical personnel in the U.S.S.R. may be summarized as follows:

(a) The social position of scientists or technicians in the U.S.S.R. is extremely high. They are the elite of the country regardless of their political faith so long as they do not commit an overt act hostile to the regime. During the war they were given special privileges in regard to food, clothing, shelter, etc. Many of them were exempted from military service. During the siege of Leningrad young scientists were evacuated to Lake Ladoga, while the rest of the population was left to starve.

The government evidently takes the attitude that scientists and engineers are of the greatest importance to the national economy. Yet the slightest criticism of communism is severely punished regardless of the status of the scientist. This was especially true during the great purges of 1935-37 when many outstanding scientists were shot.

(b) There is a very elaborate and apparently effective system of supplementary training no matter how high the position of the scientist is, such as refresher courses, periodic reviews of activity, etc. No scientist or engineer is allowed to "go to seed".

(c) There is a very efficient system of competition in science and technology, excellence of performance being highly rewarded by various prizes, medals, decorations, etc.

(d) Teaching and research in science and technology are very closely connected. In various universities and instructional institutes a great deal of research is being done. In many purely research institutes some training is offered in post-graduate work.

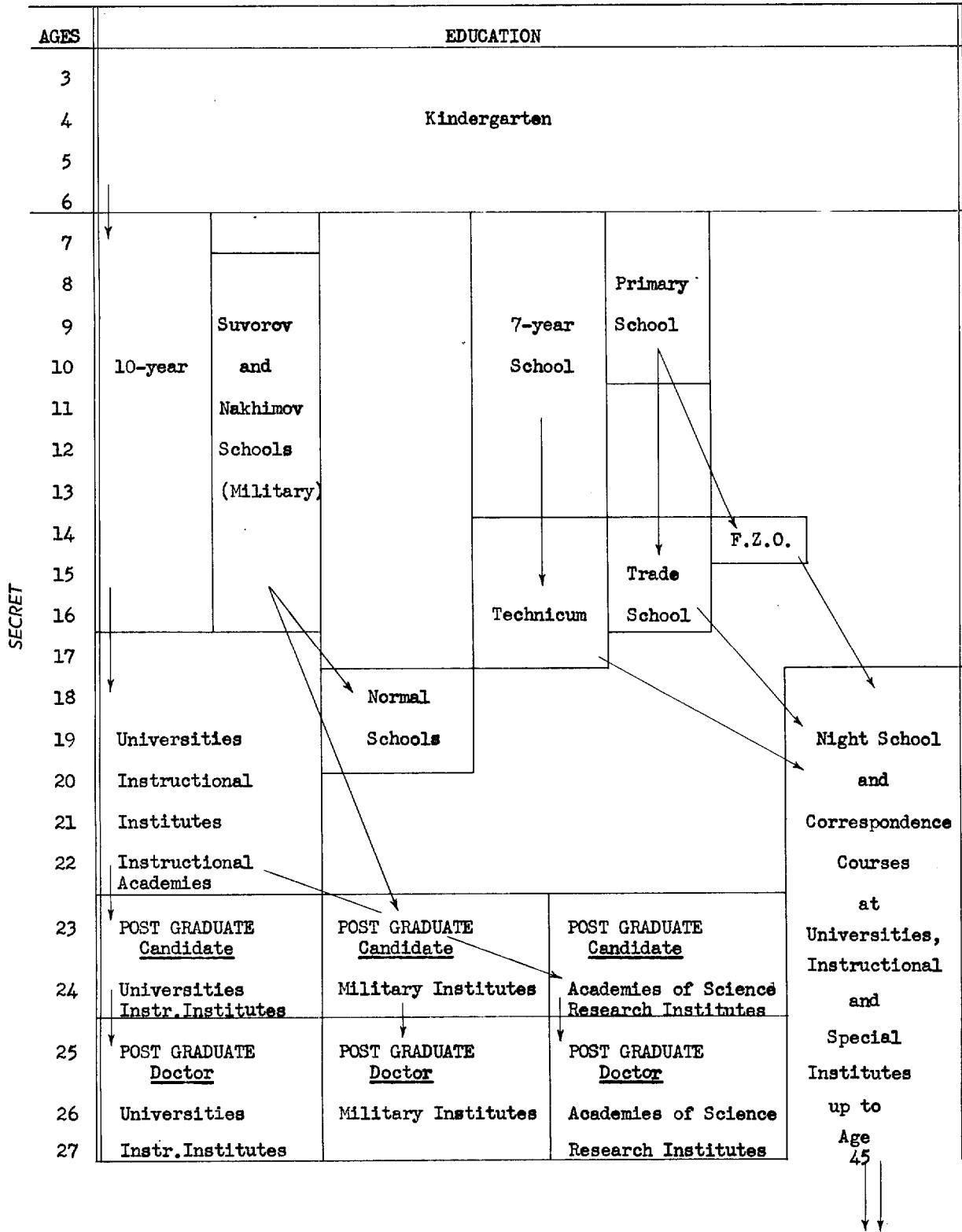
(e) All research, teaching and training is closely connected with political life. There is no such thing as neutral science.

The organization of Soviet education and technical training is a very complex subject not to be fully explained in a few pages of a report. We can hope here to give only enough background for the discussion of training in geodesy and cartography in Soviet institutions. Comparison of Soviet sources of 1946 and 1950 shows that considerable changes in Soviet education took place in this interval, and undoubtedly are still taking place.

In general, the Soviet system of training has three subdivisions:

1. Nachal'naya Shkola, (the "Beginning" School) more or less equivalent to the American Elementary School.
2. Srednyaya Shkola, (literally the "Middle" School) the last four years of which may be considered as equivalent to the American High School.
3. Vysshaya Shkola, (literally the "Higher School) of university and college level.

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Note: —————> represents normal flow of students

Figure 1.

There are, however, in the U.S.S.R. many schools for which no precise American equivalent can be found. In this category for instance, are the technicums (about 3,500) which exist for almost every industry and technology which the Soviets include in the system of Srednyaya Shkola.

Fig. 1 shows the various types of schools in the Soviet Union, the age groups represented in each, the political unit to which each age group is assigned, and the normal flow of students from one type of school to another.

#### A. LOWER EDUCATION

The level of compulsory education in the U.S.S.R. in 1946 was the elementary school of four years for children of 7 to 11 years of age. However, this level was supposed to have been raised to the seven year school; that is, up to the age of 14. In 1946 this educational level was obligatory in cities and towns, but apparently not in the whole country <sup>1</sup>.

In this report we are concerned only with those aspects of lower education which supply skilled workers for factories and industrial establishments. After a very complicated history involving many stages and plans for the training of skilled workers the Soviets have finally developed a system known as the FZO (Fabrichno-Zavodskoye Obucheniye); that is, Factory and Mill Training). A special ministry, Ministerstvo Trudorvykh Rezervov (Ministry of Labor Reserves)\*, is in charge of the FZO, and publishes a periodical, "Proizvodstvennoye Obucheniye" ("Production Training").

\* Ministry of Labor Reserves since March 15, 1953 is in the new Ministry of Culture (Ministerstvo Kul'tury).

Adolescents of 16-18 years of age not attending the regular high school or any other specialized school, are drafted for a period of from half a year to one year depending on the character of the training. They are assigned to training schools at factories and mills, are supported by the government and, after graduation, distributed according to their specialties.

In addition to the FZO schools, there are two other types of schools also administered by the Ministerstvo Trudovykh Rezervov (Ministry of Labor Reserves). They are: Remeslennyye Uchilishcha (Trade Schools) and Zheleznodorozhnyye Uchilishcha (Railroad Schools). Most of these schools have courses around two years in length.

Up to 1946, some 4,530,000 workers had received this training. The goals were enlarged for the Fourth Five-Year Plan, but they were not achieved. The numbers of graduates from labor reserve schools has declined since 1948. This decline appears to be a consequence of the raising of the level of compulsory education to 7 years and the extension of 10-year education, which reduced the number of students available for training in special trade schools. The table shows the planned and actual numbers of workers trained as skilled workers.\*

	<u>Planned</u>	<u>Actual</u>
1946	450,000	---
1947	760,000	---
1948	980,000	1,000,000
1949	1,090,000	723,000
1950	1,250,000	494,000
1951	---	400,000

**B. INTERMEDIATE EDUCATION IN GENERAL**

In addition to the ordinary middle school (Srednyaya Shkola) there are in the U.S.S.R. numerous schools of specialized training known as "tekhnikumy" (Technicums), "uchilishcha" and "shkoly" (both latter terms meaning schools). Generally speaking, technicums give technical and agricultural training, uchilishcha offer instruction in education and art, and shkoly in public health. However, there are many exceptions to this rule.

General supervision of this system is given by the Ministry of Higher Education, but financial and administrative aspects are handled by the corresponding ministries and directorates.

Young people enter these schools with a seven year record of middle school; that is, at the age of 14 or over. The term of instruction is usually from 3 to 4 years. However, students with a complete middle school record of 10 years may also enroll in a technicum. In this case, the length of instruction is shortened.

Nothing definite can be stated as to the status of these schools. The situation varies considerably in different branches of science and technology. The eleven technicums in the system of GUGK are discussed in detail later in this report. The conclusion derived from a study of these is that they are certainly above the level of the American high school and correspond better to the American Junior College of specialized training. Whether this statement is true of technicums in general is impossible to decide without detailed study. It is to be noted that the Srednyaya Shkola is administered by the Ministry of Enlightenment, whereas technicums, etc., belong to the system controlled by the Ministry of Higher Education. Therefore, it would seem that the Russians themselves



consider technicums on a somewhat higher level than ordinary high schools.

The purpose of technicums is to supply technicians to carry out work under the direction of engineers. Soviet educators assert (Medynskiy, ref. 1, pp. 157-158) that intermediate technical education is not a blind alley out of which there is no exit. A graduate of a technicum can, for instance, enter an institution of higher education by passing a special examination after serving three years in the practice of his specialty. Especially talented young people (up to five percent of the total) may be released from this compulsory service to institutions of higher education immediately after graduating from a technicum. (See Appendix B).

The list of technicums, uchilishcha and shkoly as of 1948 is <sup>2</sup> as follows:

	<u>Number of Technicums</u>
1. Mining and Fuel Industry	96
2. Metallurgy	58
3. Power and Electrical Engineering	167
4. Chemical and Rubber Industry	34
5. Light and Textile Industry	56
6. Food Industry	110
7. Lumber and Paper Industry	53
8. Labor Reserves	21
9. Polygraphic Industry	4
10. Construction	151
11. Transport	148
12. Communications	19
13. Geology, Geodesy and Meteorology	21
14. Industrial Technicums of Various Types	51
15. Agriculture	550
16. Forestry	22
17. Economics and Law	235
18. Education	701
19. Cultural - Educational Institutions	73
20. Art and Crafts	194
21. Public Health	635
22. Physical Culture	<u>43</u>
Total	3,442

**C. HIGHER EDUCATION**

According to the latest data <sup>3</sup> there were 849 institutions of higher education (Vysshaya Shkola) in the U.S.S.R. in 1950 and 885 in 1952. Another source,<sup>4</sup> gives for 1946 only 792 institutions. This means that in a six-year period the number of institutions of higher learning in the U.S.S.R. increased by 93. This is a very significant fact requiring no further comment.

None of these sources mentions the institutions of higher learning connected with various defense and military organizations. There are at least 30 of these.

The primary task of all these institutions of higher education is, of course, instruction and training of students. Nevertheless, considerable research is also being done, obviously differing in amount and quality from institution to institution. The main decree pertaining to research work at the institutions of higher education is that of SNK\* of February 18, 1944, No. 178, supplemented by several others. This decree defines the purpose of research work as follows:

- (1) Development in the institutions of higher learning of scientific personnel who are not afraid to depart from the old, conventional, scientific methods and who are able to strike out in new directions.
- (2) Participation of professors in research necessary for national economy and defense of the country and in further progress of science and culture in the Soviet Union.

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\* Soviet Narodnykh Komissarov - Council of Peoples Commissars, now the Council of Ministers.

(3) Improvement of scientific status of professors.

(4) Instruction of students in the formulation and solution of scientific and technical problems and the selection of the most promising students for research work.

There are many forms of encouragement given for research work performed at institutions of higher learning, such as prizes, citations, additional remuneration, etc. The general idea seems to be to prevent professors from scientific stagnation and make them participate in the scientific and industrial life of the entire country.

Decree No. 2000 of SNK dated November 1, 1937, defines the normal working day for the teaching staff of institutions of higher learning as six hours. Out of these six hours professors and teachers depending on this status must devote from 2.25 to 3.50 hours to working with students with remaining time to be devoted to research and improvement of teaching.

There is no question that research in institutions of higher education is encouraged in every way by the government. There is also no question that in some institutions a great deal of research is being done as is evidenced by the fact that many such institutions publish their own serial or serials. Some of these, such as the publications of the Moscow and Leningrad Universities, are very imposing. However, it may well be that even with the best of intentions professors simply cannot find time for research because of the demands of their primary responsibility of teaching.

Recent discussions in Russian literature distinctly indicate that the amount of research done in the institutions of higher learning is not

as great as envisaged by the government. For instance, in discussing the training of geographers at universities, V.N. Sementovskiy <sup>5</sup> states that duties connected with teaching take 80 to 90 percent of a professor's time, not the 50 percent planned. For research an average professor has only 10 to 20 percent of his time. On the other hand, N. I. Aleksakov, <sup>6</sup> reviewing the situation at the Moscow Institute of Mechanical Engineers, comes to the conclusion that lack of research simply means lack of organization. Describing measures taken to increase research at his institute, he states that in 1948 scientific personnel had been working on only four topics, but that in 1951-54 research projects were underway.

The detailed organization of these numerous institutions of higher education underwent many changes during the 1917-1950 period. At present the most important institutions are under the supervision of the Ministry of Higher Education, U.S.S.R. (Ministerstvo Vysshego Obrazovaniya, SSSR).<sup>\*</sup> This Ministry has eleven main administrations (Glavnoye Upravleniye) to which the corresponding institutions are assigned. Thus 33 universities and six institutes are in the Main Administration of Universities, etc. For the year of 1950 they were divided as follows:

<u>Administration of</u>	<u>No. of institutions</u>
1. Universities	39
2. Polytechnical Schools	25
3. Machine Building Schools	28
4. Mining and Metallurgy Schools	22
5. Chemical Technology Schools	17
6. Civil Engineering Schools	23
7. Light Industry Schools	8
8. Forestry and Wood Techn. Schools	12
9. Agricultural Schools	71
10. Economic Schools	27
11. Law Schools	10
Total	<u>282</u> Schools

<sup>\*</sup> In the reorganization of March 15, 1953 Ministerstvo Vysshego Obrazovaniya was combined with two other ministries and various other organizations into a new ministry known now as Ministerstvo Kul'tury (Ministry of Culture).

There are many other ministries and administrations in the U.S.S.R. as well as ministries of individual republics to which other institutions of higher education are assigned. Of these, at least from the point of view of numbers, ministries of enlightenment to which 377 pedagogical and teachers institutes are assigned (in 1952), and ministries of health which account for 74 medical institutes (in 1952), are especially important. Regardless of what Ministry the educational institution is listed under, the Ministry of Higher Education exercises definite control over programs of instruction, the general educational setup and especially in the award of advanced degrees.

In contrast to this network of educational institutions there are some 1,000 research institutes whose primary, and often the only, activity of the staff is research. Such institutes are attached to the

- (a) Academy of Sciences U.S.S.R., or to the Academies of Sciences of individual republics. In this system alone there are some 200 research institutes, the main Academy accounting for something like 60 institutes.
- (b) Other Academies (such as the Academy of Agricultural Sciences) and universities.
- (c) Individual ministries, independent bureaus and directorates.

The research institute attached to the Main Administration of Geodesy and Cartography is known as the Tsentral'nyy Nauchno-Issledovatel'skiy Institut Geodezii, Aeros'yemki i Kartografii (that is, Central Scientific-Research Institute of Geodesy, Aerial Survey and Cartography). The organizational scheme of such institutes is a very difficult thing to unravel due to frequent changes and lack of recent Soviet sources. In 1935

for instance there were 127 research institutes in the Commissariat of Heavy Industry. This commissariat was replaced in 1946 by a number of ministries and the institutes were accordingly redistributed. It should be noted that research institutes connected with various ministries of defense have only identifying numbers and not even names. Such, for instance, is Research Institute No. 108 which was attached in 1946 to the Commissariat of Electrical Industry. The highest number so far encountered is No. 627, also assigned to the Ministry of Electrical Industry. The whole problem of numbered research institutes is part of the system of secrecy in science and technology which is much more striking in the U.S.S.R. than in any other country. One might say that science in the U.S.S.R. is an iceberg, the larger part of which is hidden from sight.

almost any research institute would have a secret department, the work of which is not known to the general staff of the institute. Indeed, references are made to this secret work in official publications. Projects are sometimes listed in which work has been carried out but the results withheld from publication.

The Ministry of Higher Education exercises control over some research institutes, regardless of their affiliation, through a system of advanced academic degrees and professional titles. This is done through the Vysshaya Attestatsionnaya Komissiya (Supreme Attestation Committee) of the Ministry.

Although Soviet degrees were established in 1934, decree No. 464, of March 20, 1937, re-affirms the following academic degrees:

- (1) Candidate of Science,\* and
- (2) Doctor of Science.

These degrees can be taken in 18 specified branches of study, the official designation being not simply Doctor of Science, but Doctor of Technical Sciences, Doctor of Geographical Sciences, etc.

People (aspirants) working for the advanced degrees are assigned to various specified institutions of higher learning as well as to some research institutes. The list of these institutions and research institutes is given in decrees of SNK No. 464 and No. 558. In 1946 there were 216 institutions which could grant degrees of both candidate and doctor, and 130 which could grant only the degree of candidate. The number of these institutions is rapidly increasing. From a report<sup>7</sup> on the activity of the Vysshaya Attestatsionnaya Komissiya for the academic year of 1949-50, it is seen that the number of institutions in the first group was 470 and in the second, 278.

The fact that the university or research institute does not award the Doctor's degree, but merely recommends its awarding which is actually done by the Vysshaya Attestatsionnaya Komissiya, is also noteworthy. On the other hand, the award of the Candidate's degree is made by the institution in which the study was carried out, but must be confirmed by the Vysshaya Attestatsionnaya Komissiya.

In 1949-50 the Vysshaya Attestatsionnaya Komissiya conferred 484 Doctor's degrees and 4,536 Candidate's degrees were awarded by different institutions.

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\* For a comparison with American degrees, see footnote on p. 22.

Rules governing training for advanced degrees (aspirantura), lists of institutions and specialties in which aspirants may work for a degree, etc., may be found in a special publication <sup>8</sup>.

Decree No. 464 also establishes professional titles in a two-fold sequence, one for institutions of higher education and the other for research institutes. They are as follows:

<u>Institutions of Higher Education</u>	<u>Research Institutes</u>	<u>Qualifications</u>
Professor	Professor	Doctor's degree
Dotsent	Starshiy Nauchnyy Sotrudnik (Senior Scientific Aide)	Candidate's degree
Assistant	Mladshiy Nauchnyy Sotrudnik (Junior Scientific Aide)	Diploma Showing Completion of Higher Education.

The title of Professor, Dotsent and Starshiy Nauchnyy Sotrudnik are conferred by the Vysshaya Attestatsionnaya Komissiya upon recommendation of the institution of higher education or of the research institute. The other titles are conferred by the particular institutions to which the person is attached. In 1949-50 the Commission conferred the titles:

Professor	571
Dotsent	1811
Starshiy Nauchnyy Sotrudnik	1546

This description, of course, does not give the complete picture of the Soviet educational and research organization. Besides the official titles described above there are many employees who are simply called teachers (prepodavateli) of various types as well as special assistants.



The peculiar difficulty in following careers of Soviet scientists is the fact that they are connected with several organizations. One and the same person may be listed on the staff of half a dozen institutes. This is to be explained by the low pay of professors who had to have several jobs in order to stay alive as well as by the rapid expansion of the educational and research institute system and consequent lack of qualified personnel.

However, with the introduction of a standardized system, this multiple employment is to be permitted no longer according<sup>9</sup> to the decree of March 6, 1944. It would appear that the Soviets consider that they have finally solved the problem of sufficient scientific personnel.

Footnote: A comparison of Soviet and American academic degrees is not simple. The Candidate of Science degree has been variously equated with the American Master's and Doctorate degrees. On the basis of formal requirements, the Candidate degree is conferred after the completion of three years of post-graduate study and the defense of a dissertation. This would appear to make it comparable to an American Master's degree plus the completion of pre-doctoral requirements. On this basis the Soviet and American Doctorate degrees are more nearly comparable since both require only the preparation and defense of a Doctoral dissertation.

## II. CARTOGRAPHIC AND GEODETIC INSTRUCTION

Cartographic and geodetic training in the U.S.S.R. is offered in such general schools of higher education as universities and technical institutes as well as in specialized schools of geodesy and cartography. The difference in the point of view between these two types of schools is the emphasis on theory in the first and on practical applications in the second.

At universities the larger subdivisions are known as "faculties" (fakul'tet) each of which has a number of "chairs" (kafedra). The chair consists of a chairman, usually a senior professor with a doctor's degree, and a number of other professors, dotsents, teachers, etc. Generally, cartographic instruction is given in the faculties of geography, instruction in geodesy in the physical-mathematical faculties. Detailed data concerning university training in geography is available, but our information pertaining to geodesy is less voluminous. Although it is probable that some instruction in geodesy is given at all universities, only two of them (Voronezh and Leningrad) are listed as offering advanced degrees in that science. In addition, three universities (Moscow, Kazan' and Leningrad) offer advanced degrees in gravimetry.

### A. UNIVERSITIES

The search for data concerning the training of geographers in the U.S.S.R. takes us back to 1884 when geography first began to be taught at universities. In 1910 at St. Petersburg a Geographical Bureau was established to coordinate the teaching and research in geography. In 1916 an Institute of Geography was opened in St. Petersburg and existed until 1924 when it became the Geographical Faculty of Leningrad University. Even then

the institute was a very large organization. In 1920 it had 16 chairs, 22 laboratories and 715 students<sup>10</sup>. At the present time there is no special institute of geography for training of students outside of universities. It is interesting to note that the re-establishment of such a central institute is now advocated<sup>11</sup>.

The contribution made by universities toward the mapping and charting of the U.S.S.R. can by no means be neglected. They train teachers of geography for schools of higher education, research workers for the Academies of Sciences and research institutes, as well as professional cartographers for organizations engaged in mapping activities. In addition to training of students, an impressive amount of research is being done at universities on the problems of geography, cartography and astronomy in its geodetic application.

The necessity for employment of trained and experienced geographers to collect and edit cartographic materials was realized as early as 1924, and in 1936 professional geographers were added to the staff of various aerogeodetic establishments. Since then several orders have been issued by the GUGK finally culminating in No. 321 order of October 29, 1945. This order defined the character and contents of geographic work in connection with the mapping of the territory as follows<sup>12</sup>:

The work of the geographer would consist of

- (1) Preparatory investigation, collection of available materials, etc.
- (2) Field work for the purpose of interpretation of aerial photographs, editing of maps and compilation of geographic descriptions.
- (3) Collection and transcription of geographic names.
- (4) Laboratory interpretation of aerial survey material.
- (5) Editing of compiled sheets.

(6) Preparation of geographic descriptions.

In regard to the last item it should be noted that by order No. 101 of the GUGK of May 9, 1944, geographic descriptions must accompany all topographic surveys and be uniformly arranged according to headings on climatology, geology, relief, hydrography, soil and vegetation and animal life. Source (12) states that in 1948 all aerogeodetic establishments possessed a large number of such descriptions.

Soviet writers maintain that the training of geographers can be done only at universities. Indeed, one of the resolutions of the conference of senior workers of the GUGK on May 23-26, 1945 called on universities to establish the necessary facilities to train geographers required by the GUGK 13.

Although exact data are unavailable, the number of geographers directly connected with the GUGK must be rather large, at least 100. In 1945 there were five geographers at the Moscow Aerogeodetic Establishment. This number was considered to be "utterly inadequate"<sup>14</sup>. Even in 1945 the total number of geographers in the system of the GUGK, judged by the above figure, must have been 50 to 60. In addition, it is known that other mapping agencies such as the Voyenno-Topograficheskaya Sluzhba (Military Topographic Service), the Glavsevmorput' (Main Administration of the North Sea Route) and many other local agencies employ geographers for cartographic purposes. Therefore, it is probable that the total number of such geographers may be at least 500, and probably many more.

Can the country furnish so many professional geographers? There cannot be much question that it can and does, although exact figures of enrollment and staff at individual universities are not available. We do know, however, that 1,113 degrees in geography were granted at Moscow University during the

period of 1917-1950. Of these, 478 were conferred during the last five years or approximately 100 per year. In 1950 5,250 students were enrolled in the faculties of geography of all universities. The annual output of geographers must be then in the neighborhood of 1,000 per year<sup>15</sup>. It is to be remembered that the period of training in Soviet universities is now five years.

These estimates are in fair agreement with those of the attendance at the 2nd All Union Congress of Geography, January 25-31, 1947. At this meeting 544 delegates attended, 90 percent of whom were university teachers or research workers. Among these were 34 members of the Academies, 140 doctors of science and 226 candidates of science. The present membership of the All Union Geographic Society is over 4,000, most of whom are professional geographers.

Sofar as the university training of geographers is concerned we must distinguish two cases: simple instruction in geography and intensive training. The latter case is indicated by the existence of "specialties" in geographic sciences and usually means that students can work for the advanced degrees of candidate or doctor at such schools.

Statistics concerning the university training of geographers are noteworthy. Of the 33 universities in the U.S.S.R., 27 offer geographic training in six general specialties. The following table gives the notations adopted for these specialties:

<u>Specialties</u>	<u>Specializations</u>
1. Physical Geography	a. History of Geography b. Physical Geography c. Geography of Polar Regions d. Geography of Soils e. Geography of Plants f. Geography of Animals

2. Economic Geography
  - a. Economic Geography U.S.S.R.
  - b. Economic Geography of Foreign Countries.
3. Cartography
4. Climatology and Meteorology
5. Hydrology
  - a. Hydrology of Land
  - b. Oceanography
6. Geomorphology

Specialties 1, 2 and 5 are further broken into several specializations of which Moscow University offers all, exception specialization 1<sub>f</sub> and Lenin-grad University offers all, except specialization 1<sub>g</sub>.

A recent discussion by one of the most outstanding cartographers in the U.S.S.R. is available<sup>16</sup>. It discusses the entire problem of training cartographers in the U.S.S.R. The author maintains that the training given to future cartographers at special institutions such as the Moscow Institute of Engineers of Geodesy, Aerial Survey and Cartography produces good technicians able to make a good map if furnished the necessary material but that the selection and analysis of material can be done only by geographers trained at universities. The difference, then, between the two types of training is that of form and content.

We have at our disposal the official handbook<sup>3</sup> for entrants to the Soviet institutions of higher education of edition 1950 and 1952. A comparison of these two editions reveals many changes indicating lack of stability of Soviet educational system. Many new schools were established in these two years, others changed their names and programs.

Sofar as the universities are concerned, there were 32 of them in 1950 and 33 in 1952. Between 1950 and 1952 the Kaunas University became Kaunas Polytechnical Institute, and two new universities were organized: Kirgizakiy

(in Frunze) and Turkmenskiy (in Ashkhabad).

The training in geography in Soviet universities is given either in special faculties of geography, or in faculties combining geology and geography (Geologo-Geograficheskiy Fakul'tet). At two universities (Vil'no and Tartu) students can become specialized in geography in the faculties of natural science. The trend in geographic training between the years 1950 and 1952 can be represented by the following table:

TRAINING IN GEOGRAPHY IN SOVIET UNIVERSITIES

	<u>1950</u>	<u>1952</u>
Separate Faculties of Geography	18	14
Combined Faculties of Geology and Geography	6	11
Other Faculties	2	2
Total	26	27

It would seem that geography is not as strongly emphasized in 1952 as in 1950, but very little can be asserted on the basis of this table alone. The combination of geology with geography is quite natural, and such subjects as geomorphology, considered by the Soviets as a geographic discipline, can as well be included in the cycle of geological sciences. However, further comparison of the sources of 1950 and 1952 indicates rather definitely that the training in geography was not as well provided for in 1952 as in 1950. The data of these two sources are combined in Table I. It includes 28 universities of which one (Uzbekskiy, No. 21) ceased to offer specialty in geography between 1950 and 1952. Those universities that had separate faculties of geography in 1952 have an asterisk after their number. In the list of specialties those abolished by 1952 are put in parenthesis. Furthermore, for many univer-

sities the specialties physical geography and economic geography, distinguished in 1950, are called simply "geography" in 1952. For such cases specialty No. 2, physical geography, has an interrogation sign.

The most remarkable reduction of training is in cartography. Instead of nine universities offering this specialty in 1950, only five continued to do so in 1952. The reason for this situation could not be established. It may indicate an abundance of cartographers produced by the professional schools, or simply lack of competent instructors.

TABLE I  
SPECIALTIES IN GEOGRAPHY  
1950-1952

<u>University</u>	<u>Specialties</u>					
	1	2	3	4	5	6
1. Azerbaydzhanskiy (Baku)	*	?*				
2. Belorusskiy (Minsk)	*					
3.* Voronezhskiy (Voronezh)	*	?*	(*)	(*)	*	
4. Dnepropetrovskiy (Dnepropetrovsk)	*	?*				
5.* Yerevanskiy (Yerevan)	*	*				
6. Irkutskiy (Irkutsk)	*	?	(*)			
7.* Kazanskiy (Kazan')	*			*		(*)
8. Kazakhskiy (Alma-Ata)	*	?*				
9.* Kiyevskiy (Kiyev)	*	*	*	*	*	*
10.* Latviyskiy (Riga)	*	?*				
11.* Leningradskiy (Leningrad)	*	*	*	*	*	*
12.* L'vovskiy (L'vov)	*	*				
13. Molotovskiy (Molotov)	*	?	(*)		*	*
14.* Moskovskiy (Moscow)	*	*	*	*	*	*
15. Odesskiy (Odessa)	*	?*		*	*	
16. Rostovskiy (Rostov)	*	?*				
17.* Saratovskiy (Saratov)	*	*	*	*		*
18.* Sredneaziatskiy (Tashkent)	*	?*	(*)		*	*
19. Tbilisskiy (Tbilisi)	*	?*		*	*	*
20.* Tomskiy (Tomsk)	*	?*		*	*	
21. Uzbekakiy (Samarkand)	(*)					
22.* Ural'skiy (Sverdlovsk)	*	?*	*			
23.* Khar'kovskiy (Khar'kov)	*	?*				
24.* Chernovitskiy (Chernovitsy)	*	*	*	*	*	*
25. Vil'nyuskiy (Vil'nyus)	*	?				
26. Tartuskiy (Tartu)	*	?				
27. Kirgizskiy (Frunse)	*	?				
28. Turkmenakiy (Ashkhabad)	*	?				



The most striking characteristic of Soviet geography, as of Soviet science in general, is its directness, a directness toward a single goal. Many samples may be offered to illustrate this point. At the above mentioned 2nd All Union Geographic Congress almost every paper (of which there were over 200) dealt with specific applications of geographical methods for mapping of natural resources, exploration of marginal territories, cartography, etc. Special emphasis is placed on the interaction of man and nature, and pointed toward Soviet attempts better to control nature. Volume 23 of the serial, "Voprosy Geografii" (1950), is devoted entirely to the subject of "Nature of the Steppes and of Forest-Steppes and its Transformation." The theme appears to be to define the role of geographers in this national project. The Institute of Geography of the Academy of Sciences, U.S.S.R., is bitterly criticized for its detachment from this problem of the control of nature.

The character of training in geography given at universities is best known for Moscow University. Here emphasis is on practice. Large and small expeditions are sent to all parts of the country. After the war these included large expeditions to Eastern Siberia, the Caspian Depression and the Central Chernozem Region. The results of these expeditions were published as follows:

Eastern Siberia - 12 papers, totaling 500 pages.

Caspian Depression - 12 papers, totaling 400 pages.

Central Chernozem Region - 15 papers, totaling 1,000 pages.

In 1950 16 aspirants, 127 senior students and 55 members of the staff participated in these expeditions. Response of local agencies to the results of such expeditions appears to be quite enthusiastic. In 1949 the ispolkom (governing body) of Irkutsk Oblast' petitioned the Ministry of Higher Education and the Moscow University administration to allow the Geographic Faculty of the university to continue its work of exploration in that province "since the complex study of nature and economy carried out by university expeditions is necessary for the rapidly expanding industrial economy of Eastern Siberia" 11.

Much the same picture of activity could be drawn for the Faculty of Geography at Leningrad University, although perhaps on a somewhat smaller scale.

The relative strength of various geographical faculties can be judged by their right to accept aspirants for the degree of doctor or candidate of science. The list of subjects in which aspirants can do work reads somewhat differently from the list of specialties given in Table I. The following (Table II) represents information extracted from source (8) of 1949 and gives a list of universities authorized to give training for both doctor's and candidate's degree (D) in specified subjects or only the Degree of Candidate (K). The number gives to each university is the same as that of Table I.

TABLE II

ADVANCED DEGREES IN GEOGRAPHY  
AND RELATED SCIENCES

1. Azerbaydzhanskiy	K:	Physical Geography; Economic Geography
2. Belorusskiy	K:	Physical Geography; Economic Geography
3. Voronezhskiy	D:	Economic Geography
	K:	Climatology; Cartography and Geodesy
7. Kazanskiy	D:	Physical Geography; Gravimetry
	K:	Climatology
9. Kiyevskiy	K:	Physical Geography; Economic Geography
10. Latvivskiy	K:	Geography of U.S.S.R.; General Physical Geography
11. Leningradskiy	D:	Physical Geography; Economic Geography;
		Botanical Geography; Geomorphology; Hydrology
		of Land; Cartography; Climatology; Oceanography;
		Geodesy and Gravimetry
12. L'vovskiy	K:	Physical Geography
13. Molotovskiy	K:	Physical Geography
14. Moskovskiy	D:	Physical Geography; Economic Geography;
		Cartography; Gravimetry
16. Rostovskiy	K:	Economic Geography
17. Saratovskiy	K:	Physical Geography; Economic Geography
18. Sredneaziatskiy	D:	Physical Geography; Economic Geography
19. Tbilisskiy	D:	Physical Geography; Economic Geography
20. Tomskiy	K:	Physical Geography; Economic Geography
23. Khar'kovskiy	K:	Physical Geography; Economic Geography
25. Vil'nyusskiy	K:	Physical Geography
27. Mosk. Ped. Institut im. Potemkina	D:	Physical Geography;
		Economic Geography
28. Mosk. Ped. Institut im. Lenina	D:	Physical Geography;
		Economic Geography

Except for the scale the structure of the Geographical Faculty of Moscow University is probably typical of all universities. The faculty consists of 14 chairs under chairmen who are not necessarily the strongest specialists in the subject. Each chair has, in addition to a chairman, four or five professors, dotsents or teachers. The total number of persons in the teaching and research staff was 95 in 1950. The faculty is headed by the dean (K. K. Markov) who is also chairman of the paleogeography section.

In 1949 there was the following organization of the Geographic Faculty of Moscow University <sup>17</sup>.

1. General Physical Geography (Professor B.P. Orlov).
2. Physical Geography U.S.S.R. (Dotsent A.I. Solov'yev)
3. Physical Geography of Foreign Countries (Professor A.S. Barkov)
4. Economic Geography of the U.S.S.R. (Professor Yu. G. Saushkin)
5. Economic Geography of Foreign Countries (Professor I.A. Vitver)
6. Geomorphology (Professor I.S. Shchukin)
7. Geodesy and Cartography (Dotsent P.V. Denzin)
8. Hydrology (Professor S.D. Muraveyskiy)
9. Climatology (Professor B.P. Alisov)
10. Botanical Geography (Professor V.N. Sukachev)
11. Geography of Soils (Professor I.P. Gerasimov)
12. Paleogeography (Professor K.K. Markov)
13. Geography of the Arctic (Professor V.G. Bogorov)
14. History of Geography (Professor K.A. Salishchev)

The faculty of geography also includes a research institute of geography (Nauchno-Issledovatel'skiy Institut Geografii) and three geographic stations for student training.

The relationship between the research institute and the faculty of geography is not quite clear. Apparently, personnel is much the same for both with a few additional people assigned to the institute with research duties only. Of the 65 participants in expeditions of the Moscow University organized by the faculty of geography and by the research institute, 13 hold the title of "sotrudnik", implying research duties only<sup>18</sup>.

Detailed information on the structure of geographic education is not as available for Leningrad University as it is for Moscow University. In a discussion of the work of the faculty of geography at Leningrad<sup>19</sup> 17 members of the faculty are mentioned. The total number of the members of the faculty must, therefore, be more than 17, perhaps 30 or 40, but, at any rate, smaller than at Moscow. The dean of the faculty is Professor S.S. Kuznetsov. The Leningrad faculty of geography has its own research institute known as "Gео-графо-Економический Институт", the work of which apparently emphasizes economic geography. One of the participants in the discussion was a "Starshiy Nauchnyy Sotrudnik" (Senior Scientific Aide), a research title.

The problem of geographical education in the U.S.S.R. is apparently now quite acute. The Ministry of Higher Education established a commission to look into the matter and some of its recommendations are available <sup>15</sup>. One difficulty is undoubtedly the lack of qualified personnel to give proper instruction to so many students. In 1951 the staff of geographical faculties of universities included 61 doctors and 131 candidates, of which one half were either at Moscow or Leningrad universities. Assuming the same ratio of doctors and dotsents to other instructors as at Moscow University, the total number of instructors in geography at all universities must approximate 340. This gives the ratio of students to instructors as between 15 and 16, which is considered quite "inadequate". The suggested remedy is to separate instruction at universities into two categories, one for teachers and another for prospective workers in research institutes and production establishments. This latter training will be given only at the strongest universities - Moscow, Leningrad, Kazan' and Tashkent.

Table II lists degrees in gravimetry and geodesy which are conferred by faculties other than those of geography. The contribution of universities to the subject of gravimetry has been very large, especially before the war. The universities of Leningrad, Moscow, Kazan' and Tashkent (Sredneaziatskiy) are especially important in this respect. In 1949 the chairman of gravimetry at Moscow University was Professor L.V. Sorokin, one of the outstanding gravimetrists in the U.S.S.R., especially known for his undersea measures of gravity.

Another connection of Moscow University with geodesy is through the Astronomicheskii Institut im. Shternberga (Sternberg Astronomical Institute) where an amazingly detailed study of the methods of determination and of variation of astronomical time is being carried on.

The problem of research versus teaching is as acute in Soviet universities as anywhere else. In large centers like Leningrad and Moscow a great deal of research is accomplished by the university staff. In provincial universities the situation is probably not as favorable for research. At least we have the complaint of a geographer <sup>5</sup> from Kazan' that much more time than the stipulated 50 percent must be devoted to teaching activities and less to research.

In order to give a rounded picture of Soviet training in geography mention must be made of the Pedagogicheskiy Instituty (Pedagogical Institutes). These institutes are primarily designed for the training of teachers for middle schools (Srednyaya shkola) but considerable research of local significance is carried on in some of them. This research results in such items as guide-books, detailed investigations in the geography of individual regions, compilations of bibliographies, etc.

Of the 137 pedagogical institutes, 65 had specialties of geography in 1952. Two of them in Moscow (Table II) can even accept aspirants for the degree of doctor of geographical sciences.

Teachers' institutes (Uchitel'skiye instituty) prepare teachers as elementary school instructors. Of these institutes, 162 offer specialties in geography (1952).

The total number of students majoring in geography in both types of institutes in 1951 was 22,500 <sup>15</sup>.

Soviet authors attach extraordinary significance to the availability of so many persons with a geographical background. The two volumes of "Voprosy Geografii", No. 23 (1950) and No. 25 (1951), are largely devoted to a discussion of the role of teachers of geography in regional studies (krayevedeniye) and in inculcating students with the idea of man's mastery

over nature. In the words of S.V. Kalesnik, a noted glaciologist at Leningrad University, "geography used to mean the study of landscape; with us geography is control over landscape."

B. OTHER INSTITUTIONS OF HIGHER EDUCATION

1. Khar'kovskiy Inzhenerno-Stroitel'nyy Institut (Khar'kov Institut of Civil Engineers), Khar'kov, Sumskaya No. 40.

Prior to World War II this Institute was very active in the training of geodesists. Its faculty of geodesy was described as being one of the three geodetic schools in the U.S.S.R. <sup>20</sup>, along with the Moscow and Novosibirsk Institutes of Engineers of Geodesy. In 1940 the Khar'kov Institute of Civil Engineers graduated 89 geodesists. For the school year, 1940-1941, the following enrollment figures were set:

Moscow	400 students
Novosibirsk	150 students
Khar'kov	75 students

Perhaps prior to 1939 there existed an independent institute of geodesy in Khar'kov. For 1939 we have <sup>21</sup> a definite statement that the Khar'kov Institute of Civil Engineers had faculties of (a) architecture, (b) construction and (c) geodesy. The latter was subdivided into departments of geodesy and gravimetry, and of photo-geodesy (apparently photogrammetry). In the official reference books of 1950 and 1952 the geodetic faculty is not mentioned, whereas faculties (a) and (b) with two other faculties are described <sup>3</sup>.

As to the reasons for this change, nothing definite can be asserted. Obviously it was connected with the re-organization of training in the Ukraine after the disruption produced by the war. As a similar change occurred in the

school described in Section 2, perhaps we may infer that the Soviets consider the two professional schools of geodesy in Moscow and Novosibirsk adequate for their needs.

2. L'vovskiy Politeknicheskii Institut (L'vov Polytechnical Institute)  
L'vov, Ulitsa Stalina, No. 12.

The reference book <sup>3</sup> of 1950 lists a separate geodetic faculty with specializations in astronomy-geodesy and in surface field geodetic work. The 1952 edition of this book does not mention this faculty. Instead of it we find specialties astronomy-geodesy and engineering geodesy in the Geologic Prospecting Faculty. It would seem that general training in geodesy is no longer given in this school.

3. Moskovskiy Institut Inzhenerov Zemleustroystva (Moscow Institute of Land Surveyors), Moscow, Ulitsa Kazakova No. 15.

This institute has two faculties, one of land surveying and the other of geodesy. The description of its training in geodesy reads, "the engineers should be able to conduct land and aerial photographic surveys of large farming territories and prepare special maps". The training in geodesy appears to be restricted to practical application of surveying.

4. Leningradskoye Vyssheye Arkticheskoye Uchilishche (Leningrad Higher Arctic School), Leningrad, M. Okhta, Zanevskiy, No. 5.

Nothing is known about this school beyond the fact that it is in the system of the Glavsevmorput' and offers candidate degrees in hydrography, astronomy and geodesy. The training of geodesy is obviously connected with Arctic surveys. The contents of the publications of this school ("Uchenyye Zapiski", Vol. 1, 1949) reveal the existence of the chairs of astronomy and geodesy.



5. Timiryazevskaya Sel'skokozyaystvennaya Akademiya (Timiryazev Agricultural Academy). Moscow, Novoye Shosse, No. 51.

Very little is known about the geodesy curriculum of this Academy except that in 1946 a Kafedra Geodezii was included in a description of the Academy's activities <sup>22</sup>. In a later reference <sup>23</sup> the subject of geodesy is not mentioned. Presumably, geodetic work had been restricted to land use surveys of some sort but nothing is definitely known at this time.

6. L'vovskiy Sel'skokhozyaystvennyy Institut (L'vov Agricultural Institute), L'vov, ploshchad' Bogdana Khmel'nitskogo, No. 1.

A source <sup>24</sup> of 1948 lists this institute as offering a "Speciality" in geodesy. A later reference <sup>23</sup> does not include the subject in its curriculum. Geodetic work of the institute probably was much the same as that of (5) above.

7. Voronezhskiy Sel'skokhozyaystvennyy Institut (Voronezh Agricultural Institute), Voronezh, Ul. Lomonosova, 29.

Information on the geodetic activities of this Institute is exactly the same as for (6) above.

8. Omskiy Sel'skokhozyaystvennyy Institut (Omsk Agricultural Institute Omsk, Staraya Zagorodnaya Roshcha.

A reference <sup>3</sup> of 1950 states that this Institute still offered a speciality in geodesy at that time.

9. Voyenno-Inzhenernaya Akademiya imeni V.V. Kuybysheva. (Military Engineering Academy) in Moscow.

This institution trains engineers for the army. It is known that it has a department of geodesy and cartography, but very little about its de-

tailed activities has been found. Several books, however, published by this academy have been found and they indicate considerable research in geodesy, cartography and photogrammetry.

This and the following academy is listed among those institutions authorized to train students for advanced degrees.

10. Voyenno-Vozdushnaya Akademiya imeni N. E. Zhukovskogo (Military Air Academy) in Moscow (not to be confused with a similar academy in Leningrad).

This academy publishes a "Trudy" of which No. 102 appeared in 1944. None of this serial is available. The notice describing its contents, however, indicates considerable interest in the problems of geodesy and photogrammetry.

11. Voyenno-Topograficheskaya Shkola (Military Topographers School) in Leningrad.

This training school for topographers has a status lower than that of the Military Engineering Academy.

Total enrollment in these three military schools in geodesy and cartography must be rather large, of the order of about 500 people. Annual graduation of engineers specializing in geodesy should thus be in the neighborhood of 100.

A total number of engineers in geodesy, cartography and photogrammetry in the U.S.S.R. is undoubtedly large, approximating 10,000. This would exclude civil engineers carrying out cadastral work, ordinary surveyors, technicians, etc.

If we restrict our attention to the post-revolutionary period we can offer the following estimates: