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GEOPHYSICAL RESEARCH IN THE USSR

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GEOPHYSICAL RESEARCH IN THE USSR

In view of the projected cooperation between the USSR and the Western world during the coming IGY, a short account of Soviet organization of geophysical research seems desirable. Since this report may be used by persons not familiar with Soviet conditions, general discussion of research institutes, pure and applied science in the USSR, the secrecy associated with it, and the publications of the institutes is given first. The information presented below has been extracted from Soviet publications and is presumably available to anyone who is able to read them.

Research Institutes

The fundamental unit of research in the USSR is the Nauchno-Issledovatel'skiy Institut (Scientific Research Institute; NII), the scientific research institute. An NII is generally a rather large organization; some institutes are known to have staffs of over 1,000 persons. One such is the Geophysical Institute of the Academy of Sciences, USSR.

The number of research institutes is very large, certainly over 2,000. Assuming the average figure of 100 scientists per research institute, 200,000 Soviet scientists are engaged in research. This seems incredible, but the following considerations should be taken into account.

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(a) Most Soviet scientists have multiple connections, so that they are counted at least twice in the total. An outstanding scientist may be on the staffs of half a dozen research institutes.

(b) In the Russian language, "science" has a broader meaning than in English. The Academy of Sciences, USSR, has a whole large division of "technical sciences," which are simply technology. In specialized research institutes, most "scientists" are really engineers.

(c) The Soviets see to it that no scientific talent is wasted. In fact, under the Soviet system of education, a person having completed his training is under obligation to work for the State. There is no opportunity for such a person to make a living except in some State-supported and State-controlled institution.

(d) Scientists whose primary responsibility is teaching are under heavy pressure to carry out research studies and most of them are also on the staff of one or more research institutes.

(e) The Soviets realize the value of conscientious, routine, scientific workers who are not capable of independent research of their own but, when attached to a leader, may be extremely helpful in relieving him of the drudgery involved in any large-scale scientific investigation. Papers with 10 or 15 collaborators mentioned in the introduction are not uncommon in Soviet scientific periodicals. The large amount of assistance may help to explain the remarkable productivity of some Soviet scientists.

Pure and Applied Science

The Soviets, in theory, make a sharp distinction between pure and applied science and have therefore two kinds of research institutes:

(1) Primary (golovnyye) research institutes in the Academies of Sciences and Universities

(2) Specialized (otraslevyye) research institutes attached to various ministries and administrations.

The primary institutes are supposed to formulate problems and develop methods of investigation, the specialized institutes to apply these methods to specific problems. In reality, however, this distinction is practically nonexistent. Academic research institutes are constantly criticized for their detachment from the current problems of socialistic reconstruction; on the other hand, many specialized institutes carry out fundamental research.

The official attitude in all cases is fiercely utilitarian. "Science without practical applications, what kind of science is this?" These words of Stalin are quoted constantly. The keynote of the Academy of Sciences is cooperation with industry. The extensive seismological program of the Geophysical Institute, Academy of Sciences, USSR, is frankly based on utilitarian considerations, and much the same can be said of any other large program in geophysics. In general, any unusual activity in geophysics can be traced to a directive of some coordinating body within the Academy of Sciences, which in turn takes its cue from the government. In fact the Academy of Sciences may be said to be part of the government, since its representatives are members of the Supreme Council (Verkhovnyy Sovet) of the USSR.

This is not to say that pure research in the Western sense of the word is unknown in the USSR. In the final analysis, it is up to the scientists themselves to say what investigations are needed in order to achieve the desired practical goal. But they must justify their choice in terms of practical considerations.

In a recent paper, for instance (Priroda, Vol. 3, No. 78, 1954), extensive program is proposed for the observation of the planet Mars in the coming great opposition of 1956. Mars should be observed not simply because it is interesting to learn something about the planet, but because it presents a good opportunity to test the aerodynamical theories of Soviet scientists Kibel, Fridman, and Kochin.

It is important to notice that the proposed cooperation with the Western world (and currently the Soviet press is enthusiastic about it) is to be done through the first group of institutes and, more specifically, through the Academy of Sciences, USSR. Nothing had been said about the specialized research institutes until a recent Soviet announcement stated that leading scientists of GUGMS and GUSMP (abbreviations explained later) would participate in the Soviet Antarctic program. No mention was made of GUGK. This group of institutes involves some of the most important organizations from the geophysical point of view. The recent decision to adhere to the International Union of Geodesy and Geophysics (IUGG) also comes from the Academy of Sciences, USSR (Priroda, Vol. 3, No. 62, 1955).

Secrecy in Science

From the very beginning of the Soviet regime, science (and especially engineering) has been recognized as the key to the mastery of the world. Up to the beginning of World War II, practically no effort was made in the West to conceal scientific progress, but as early as 1920 the Soviets considered many aspects of their scientific progress as state secrets. The Germans learned by bitter experience that the Soviet scientific and industrial potential was considerably greater than they imagined it to be.

An American scientist brought up in the idea of free scientific research will find it difficult to realize this situation, despite his own experience with classified research. To him, atomic energy and guided missiles are the only obvious fields of science in which secrecy is necessary. The Soviets, however, have extended the area of secrecy to subjects that appear to the American scientist quite outside the realm of immediate, or even possible, military application. This area of secrecy covers such geophysical topics as gravimetry, cosmic rays, geomagnetism, aurorae, etc. Concrete data on such subjects are openly published within the USSR, but they are never allowed to leave that country. Although often referred to in Soviet theoretical papers on these subjects, such sources are not available to Western scientists. We may be sure that not more than 10 percent of Soviet scientific and technical literature, openly published in the USSR, ever reaches the US.

In addition to this, there is an undetermined but very large amount of classified literature on science and technology that has a restricted circulation even in the USSR.

A few concrete examples may clarify the situation. The Research Institute of Terrestrial Magnetism (NIIZM) has been publishing a quarterly entitled Cosmic Data, which contains nothing but indices of solar activity and corresponding geomagnetic data. There is exactly one issue of this publication (March 1944) at the Library of Congress, and it is marked "For Official Use Only, No. 113." The catalogues of gravity measures and of magnetic elements in the USSR have never appeared in foreign countries, although neither publication is regarded as secret, even from the Soviet point of view.

Only recently have some cracks in this iron curtain of secrecy begun to develop. These cracks are not slips in the system but are the result of the current phase of Soviet foreign policy -- limited scientific cooperation with the West. An examination of the cracks shows better than any discussion the conditions of scientific life in the USSR.

For some years, a great interest in radio astronomy on the part of the Soviets was evident. A large number of articles on this subject have been written by Soviet scientists, invariably using Western observational data as if they had none of their own. Only last summer one of the Soviet meteor experts declared at the Manchester conference on radio astronomy that the installation of radio telescopes is being planned in the USSR, from which a casual reader would infer that no

radio telescopes were actually in existence there. However, the last issue of the Soviet Astronomical Journal (Astr. Zh., Vol. 32, No. 150, 1955) contains a detailed description of a radio-astronomy observatory in the Crimea, from which one can see that the Soviets not only have elaborate equipment at two stations, but also that they have pursued observational work vigorously since 1951. Another recent reference (Vestnik AN SSSR, Vol. 2, No. 25, 1955) indicates that such work was in progress as early as 1948. For 7 years, therefore, the innocent subject of radio astronomy has been considered secret by the Soviets!

Similarly, for years the Soviets made reference to their spectroscopic observations of aurorae without specifying the place of observation. Now it appears that this work has been in progress since 1951 at the Stratosphere Section of the Murmansk Station of the Geophysical Institute of the Academy of Sciences, USSR (Vestnik AN SSSR, Vol. 1, No. 110, 1955). Although this is a key research institute in the proposed cooperation with the West, the very existence of this station was unknown.

A veil of secrecy has also been lifted slightly from the activity of the Arctic Research Institute (ANII), but only general results, not specific data, are given (Izv. AN, Ser. Geog., Vol. 5, No. 3, 1954). Just enough has been released to indicate the remarkable activity of the Soviets in this region.

Such subjects as high-altitude-rocket research, applications of radar in meteorology, shoran, and loran are only guardedly mentioned in Soviet literature. Although there is some discussion of the subjects, the observational data used are invariably borrowed from the West. The situation here is undoubtedly the same as with radio astronomy. All evidence

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indicates great activity of the Soviets along these lines; if the present Soviet mood continues, perhaps we may hear soon of their progress.

The limitations of secrecy apply to Soviet scientists themselves. Most of them work along sharply defined lines and have a very limited knowledge of the situation outside their specialty. A very high degree of coordination is evident, but this is achieved by directives from above. In short, Soviet science is organized along military lines.

Publications

The general rule is that every research institute in the USSR has its own journal, and the larger institutes have two or more. These are generally not available in the West, although many are represented in US libraries by a few nonconsecutive volumes. The situation in the American libraries is described in the Library of Congress report "Serial Publications of the Soviet Union 1939-1951," Special Supplement to the Monthly List of Russian Accessions, Washington, 1951.

This publication, with a Monthly List to keep it up to date, gives a fair idea of the availability of Soviet publications. Even this list is not complete, and the Library of Congress may be overly optimistic when it estimates that only 13 percent of Soviet publications ever reach this country.

Publications of the Academy of Sciences, USSR (but not of other academies), are generally available; but even here there are conspicuous gaps. From the viewpoint of geophysics, the most important academic publications are: Izvestiya AN SSSR, Seriya Geofizicheskaya, which contains longer articles; Doklady AN SSSR, which includes shorter articles

on all branches of science. Some articles of geophysical interest may also be found in Izvestiya, Ser. Fizicheskaya (cosmic rays) and Ser. Geograficheskaya (glaciology).

Organizations

Research institutes, observatories, stations, etc., are assigned to various organizations, and their activities are coordinated by various councils, commissions, or committees. So far as geophysics is concerned, the following organizations* are significant:

AN Academies of Sciences. The main Academy of Sciences of the USSR (AN SSSR) has over 300 research institutes, and the 10 republican academies have 200 more. The number of scientific workers in the academies is very large, perhaps 30,000. In 1953, awards and decorations granted to outstanding workers in the AN SSSR alone numbered over 3,000. Among the republican academies, the most important for geophysical research are those of the Ukrainian, Georgian, Uzbek, and Kazakh Republics.

GU Universities. The most important universities, each of which has a large number of research institutes attached to it, are those of Moscow and Leningrad.

* A list of research units in these organizations is given in Appendix A. The abbreviations used in the list constitute one of the stumbling blocks in the use of Soviet scientific literature. The names are usually not spelled out, and the reader is often in doubt as to the identity of the institution referred to. More than 10,000 such abbreviations are now being used in Soviet literature.

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- GUGMS Main Administration of Hydrometeorological Service. This is a very large organization with 11 research institutes, some 20 geophysical observatories, and over 3,000 observation stations.
- GUSMP Main Administration of North Sea Route. This is also a large organization with several research institutes. In the Arctic Institute of this Administration, research includes all phases of geophysics in the Arctic. The Administration has five Arctic geophysical observatories and a large number (hundreds) of observing stations.
- GUGK Main Administration of Geodesy and Cartography. Most of the work of this Administration is in geodesy and cartography of no immediate interest to geophysicists. However, its TsNIIGAik directs the gravimetric survey of the USSR, and much attention is paid there to the problems of variation of latitude and longitude.

Subjects of Research

A. Solar Activity

Visual and photographic observations of the sun are naturally made at astronomical observatories, and their work is coordinated by the Solar Commission of the Astronomical Council, AN SSSR. This commission publishes a bulletin, but it is not available to the West. Some of these observatories are part of a program being carried out according to a definite plan designed to correlate solar and terrestrial phenomena. This program is known as the "Sun Service" (Sluzhba Solntsa) and is under the management of the Institute of Terrestrial Magnetism (NIIZM), which publishes the serial Cosmic Data (also not available). The NIIZM has its own heliophysical observatory at Krasnaya Pakhra near Moscow. The two institutes of communication, TsNIIS and NIIISKA, are also participating in the program, presumably in the study of the ionosphere.

The astronomical observatories in the Sun Service are:

Kazan' (Engelhardt)
Moscow (Shternberg Institute)
Simeiz (Crimea)
GAO (Pulkovo, with a solar observatory near Kislovodsk)
Tashkent
Azerbaydzhan
Abastumani (Georgian SSR)
Khar'kov
Leningrad

Odessa

Irkutsk

Kiyev

B. Geomagnetism

The main institute is the NIIZM in the system of the GUGMS. This institute has carried out a systematic magnetic survey of the USSR resulting in the primary determination of magnetic elements through the use of some 320,000 secondary determinations (1932-41). The data will be published in a series entitled "Magnitnoye Pole SSSR" (Magnetic Field of the USSR) in five volumes, of which Vols. 1 and 2 have been published. Although Vol. 2, Part 1, the general catalog, is available, Part 2 giving the secular variations is not available. The survey, however, does not extend beyond 60°N, the far north being under the jurisdiction of the ANII, which has made a very thorough magnetic survey of the Arctic and which will now participate in the Antarctic program.

The GEOFIAN (Geophysical Institute of the Academy of Sciences, USSR) has also done considerable research on terrestrial magnetism. Magnetic observatories are generally parts of the geophysical observatories, but they are situated outside the city in which the main observatory is located. In the following list, two names are therefore given for some of the observatories:

<u>Abbr.</u>	<u>Observatory</u>	<u>Latitude</u>		<u>Longitude</u>		<u>Organization</u>
		<u>o</u>	<u>'N</u>	<u>o</u>	<u>'E</u>	
AAGO	Kegen' (Alma-Ata)	43	15	76	55	GUGMS
MGO	Krasnaya Pakhra (Moscow)	55	29	37	19	NIIZM
BTGO	Bukhta Tikhaya	80	20	52	48	ANII
ChGO	Cape Chelyuskin	77	17	104	17	ANII
D1GO	Island Dikson	73	30	80	25	ANII
MShGU	Matochkin Shar	73	16	56	24	ANII
UGO	Cape Uellen	66	10	190	11	ANII
SrGO	Srednikansk	62	26	152	19	GUGMS
YaGO	Yakutsk	62	01	129	43	GUGMS
GGO	Voyeykovo (Leningrad)	59	41	30	24	GUGMS
SGO	Vysokaya Dubrava (Sverdlovsk)	56	44	61	04	GUGMS
XGO	Zaymishche (Kazan')	55	50	48	51	GUGMS
IGO	Zuy (Irkutsk)	58	28	104	02	GUGMS
LGO	Yakov (L'vov)	49	54	23	44	GUGMS
DGO	Vladivostok	43	15	132	20	GUGMS
TbGO	Dusheti (Tbilisi)	42	05	44	42	GUGMS
TGO	Keles (Tashkent)	41	25	69	12	GUGMS
KsGO	Kaumas					GUGMS
ShGO	Shatsk					GUGMS

C. Aurorae and Airglow

Regular observations of airglow are carried out at some of the astronomical observatories, notably those in the Crimea and Alma-Ata.

The zodiacal light is observed at the Ashkhabad Astrophysical Laboratory and its subordinate stations and at Alma-Ata.

So far as observations of the aurorae are concerned, the situation is uncertain. The GEOPHAN has a large program for the study of the spectrum of aurorae and airglow at Murmansk. The aurorae stations would naturally be situated in the Arctic, that is, under the jurisdiction of the ANII. In 1944 the following meteorological stations had a regular aurorae program (Kosmicheskiye Dannyye, March 1944):

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<u>Station</u>	<u>Latitude</u> ° 'N	<u>Longitude</u> ° 'E
Bulun	70 41	127 04
Yessey	68 28	102 22
Indiga	67 42	48 16
Verkhoyansk	67 33	133 23
Kovda	66 41	32 54
Salekhard	66 32	66 36
Kuzamenka	66 17	36 55
Samzha	66 08	49 09
Gridino	65 55	34 42
Turukhansk	65 47	87 57
Uel'kel'	65 33	179 13
Berkhovskaya	65 12	49 35
Kem'	65 52	34 39
Usskiy Mayak	64 50	38 39
Karkadon	64 45	153 48
Vealyany	62 59	50 54
Yarensk	62 10	49 05

In 1939, an entirely different set of arctic stations at which regular observations of aurorae were carried out was given (Problemy Arktiki Vol. 2, No. 27, 1939). This list naturally includes the five ANII arctic geophysical observatories mentioned on page 13, plus the following:

<u>Station</u>	<u>Latitude</u> ° N	<u>Longitude</u> ° E
Island Uyedineniya	77.5	82.2
Cape Zhelaniya	77.0	68.5
Bay Blagopoluchiya	77.7	63.7
Island Vrangelya	71.0	161.5
Island Chetyrekhtolbovy	70.6	162.4
Murmansk	69.2	33.0

The discrepancy probably is explained by the fact that the first set of stations is under the jurisdiction of the GUCMS, whereas the second set is under the jurisdiction of the GUSMP. At any rate, there can be little doubt that aurorae are regularly observed at some 20 to 30 Soviet stations.

It should be noted also that the VAGO (Astronomic and Geodetic Society of the Soviet Union) includes observations of aurorae in its program, and many observations of this type are published in its bulletin. The observations, however, are sporadic and refer to brighter aurorae visible in lower latitudes.

D. Ionosphere and Radio Astronomy

Research on the ionosphere is very much of a secret in the USSR, and little is published on the subject except in theoretical papers. The number and quality of these papers leave no doubt that the study of the ionosphere is being vigorously pursued in the USSR.

The known main centers of ionospheric research are as follows:

SIFTI	Siberian Institute of Applied Physics, with Tomsk Ionospheric Observatory
GIFTI	Gor'kiy Institute of Applied Physics
FIAN	Physical Institute of the Academy of Science, USSR, with a high-altitude observatory on Mt. Elbrus, Caucasus (Krugozor)
GEOFIAN	Cooperating with the FIAN in observations at Krugozor
TsNIIS	Central Institute of Communications in Moscow, with a section "LONIIS" in Leningrad, and with ionospheric observations at both places
NIISKA	Red Army Institute of Communications, with an ionospheric observatory in Moscow region
VETAS	Military Electro-Technical Academy of Communication

ANII Arctic Research Institute -- the ionospheric data of all of its five arctic geophysical observatories (see p. 13) were freely published before World War II; nothing has been heard of their activity since the war.

Until very recently, radio astronomy in the USSR has also been a deep secret. We now know that one of the centers of this research is in the Crimea (see page 7). Institutes actively engaged in research on radio astronomy include FIAN and GIFTI and, in all probability, all other institutes listed in connection with the study of the ionosphere.

The centers for research on meteors in the upper atmosphere are Stalinabad Astronomical Observatory and Ashkhabad Astrophysical Laboratory, which maintain a network of observing stations in the vicinity of Ashkhabad. Magnetic effects produced by meteors are studied at GEOFIAN and NIIZM, and radar observations are carried out by the Sternberg Astronomical Institute in conjunction with TsNIIS.

It should also be noted that much attention is paid in the USSR to the problem of noctilucent clouds, especially at the GEOFIAN and VAGO.

E. Meteorology and the Lower Atmosphere

Records are available for some 3,000 meteorological stations in the system of the GUOMS. These stations are graded into classes, a first-class station having as many as 20 people on its staff. Some research is done at such larger stations, and the results are published in the periodical Meteorologiya i Gidrologiya. The main centers of research are:

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TsAO	Central Aerological Observatory at Dolgoprudnaya near Moscow
GGO	Main Geophysical Observatory in Leningrad, Voyeykovo
TsIP	Central Institute of Forecasting, Moscow
GGI	State Hydrological Institute, Leningrad

Recently (about 1951), four Hydrometeorological Research Institutes were established in Tbilisi, Kiyev, Vladivostok, and Alma-Ata; but little is known of their activity. There is also a special research institute for hydro-meteorological instrumentation (NIIGMP) in Moscow.

The study of various phenomena in the atmosphere of the earth, such as scattering of light, transparency, star scintillation, turbulence, etc., is carried out at the GEOFIAN, FILGU (Physical Institute of the Leningrad University), and several astronomical observatories, notably those at Alma-Ata and Abastumani.

F. Seismology

The main organization in seismology is GEOFIAN, which maintains 46 seismic stations and published a quarterly, Bulletin of Seismic Stations, USSR (Byulleten' Seti Seysmicheskikh Stantsiy SSSR). As of January 1953 there were 68 permanent seismic stations in the USSR, assigned mostly to academies. This list does not include any seismic stations that may be in the Arctic.

A special Institute of Seismology is located at the Academy of Sciences of Tadzhik Republic, but very little is known of its activity.

G. Variation of Pole and Longitude

The USSR has undertaken a very large research program, both for the observation of these phenomena and for their theoretical interpretation. The goal is stated frankly to be the correlation of these astronomical phenomena with geophysical factors such as seasonal transfer of masses of air for the advancement of long-range weather forecasting.

The variation of the pole is observed at the following stations:

KMSHS	Kitab International Latitude Station
GAO	Pulkovo
AOE	Kazan'
IAO	Irkutsk
GShS	Gor'kov
PGO	Poltava Gravimetric Observatory

At PGO, AOE, and IAO, earth tides are also being observed regularly.

The Soviets maintain 10 independent time stations -- 3 in Moscow, 2 in Leningrad, and 1 each in Riga, Nikolayev, Khar'kov, Tashkent, and Irkutsk. The variation of longitude is receiving much attention, especially at GEOfIAN.

H. Gravimetry

The main institution in the development of gravimetry is the TsNIIGAIK (Central Research Institute of Geodesy, Photogrammetry, and Cartography) in the system of GUGK. A systematic survey of all USSR territory was carried

out under its direction in 1932-41 and resulted in some 20,000 pendulum determinations of gravity carefully reduced to the Potsdam System. None of this material is available outside of the USSR.

Theoretical investigations of gravity are carried out at the ITA (Institute of Theoretical Astronomy) of the Academy of Sciences, USSR, and at several astronomical observatories. At the GEOFIAN there is a special section of gravimetry, but the field work is now under the direction of the various GUGK organizations.

I. Oceanography

The outstanding academic institute for oceanography is the MGIAN (Marine Hydrophysical Institute), along with its sections in Moscow and Crimea (Katsiveli). At IOAN (Institute of Oceanology), much attention is paid to marine life. The GOI (State Institute of Oceanography), which is in the system of the GUGMS, is carrying out systematic surveys of seas adjacent to the USSR territory. In the system of the GUGMS, there are several marine observatories -- Arkhangel'sk, Vladivostok, and Petropavlovsk on Kamchatka -- but their roles are not known. Probably much important work is carried out by the Hydrographic Administrations of the Navy and of the GUSMP, but little is known of their activity.

J. Glaciology

The Academy of Sciences, USSR, includes IMAN (Institute of Permafrost), one of whose functions is the study of glaciers. The IGAN (Institute of Geography) maintains a special glaciological station in the Tyan'-Shan'

Mountains, and the Institute of Geophysics, AN Georgian SSR, is conducting a study of glaciers in the Caucasus Mountains. The most important work, however, is probably being performed at the ANII (see Section L).

K. Cosmic Rays

The most important institute for research on cosmic rays is the FIAN (Physical Institute of the Academy of Sciences, USSR), which maintains several stations at Elbrus (Caucasus Mountains) and in the Tyan'-Shan' Mountains. The Institute of Physics of the Academy of Sciences, Armenian SSR, is also active in this field.

L. Arctic Research

Arctic research is discussed here as a unit because it does not fit into any one specific phase of geophysics. The ANII (Arctic Research Institute) of the GUSMP is responsible for research on all aspects of geophysics. It is a very large institute and up to 1940 published a tremendous amount of information on all aspects of the Arctic. Since the war, however, no publications of this institute except those relating to marine life have been allowed to leave the USSR. Only recently (Vestnik AN SSR, Vol. 6, No. 76, 1954) has the curtain been lifted somewhat, just enough to show that arctic research in the USSR has continued since the war on a very large scale. The ANII is definitely known to have five geophysical observatories (Bukhta Tikhaya, Uellen, Matochkin Shar, Dikson, Chalyuskin; listed on p. 13) and probably others at Bay Tiksi (mouth of

APPENDIX

RESEARCH ORGANIZATIONS

- Main Agencies:
- I. AN (Academies of Sciences)
 - II. GUGMS (Main Administration of Hydrometeorological Service)
 - III. GUSMP (Main Administration of Northern Sea Route)
 - IV. GUGK (Main Administration of Geodesy and Cartography)
 - V. GUVUZ (Main Administration of Higher Educational Institutions)
 - VI. Miscellaneous

I. Academies of Sciences (AN)

A. AN, USSR

1. GEOFIAN (Geophysical Institute); Dir. G. A. Gamburtsev*
Murmansk Station: aurorae, upper atmosphere, 46 seismological stations
Elbrus Observatory: upper atmosphere, cosmic rays
2. FIAN (Institute of Physics); Dir. D. V. Skobel'tsyn
Elbrus Observatory: cosmic rays
Krym Station: radioastronomy
3. MGIAN (Institute of Marine Physics); Dir. V. V. Shuleykin
Krym Station at Ketsiveli: motion of poles and tides
4. IOAN (Institute of Oceanography); Dir. B. V. Kort
Arctic research; tides
5. GAO (Main Astronomical Observatory at Pulkovo); Dir. A. A. Mikhaylov
Gravity, variation of the pole
VSGAO (Kislovodsk): sun
NOGAO (Nikolayev): variation of the pole

*Deceased, 28 June 1955. - 22 -

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6. KRAO (Crimean Astrophysical Observatory, Simeiz); Dir. A. B. Severnyy
Night sky, sun, radioastronomy
7. LVAN (Kamchatka Volcanological Station); Dir. V. I. Vlodayets
Volcanology

B. AN, Ukrainian SSR

1. KGO (Kiyev Geophysical Observatory); all aspects of geophysics
2. PGO (Poltava Gravimetric Observatory); Dir. Z. N. Aksent'yeva
Variation of latitude and earth tides
3. GAO (Goloseyevo Main Astronomic Observatory); Dir. A. A. Yakovkia
Variation of latitude

C. AN, Tadzhik SSR

1. IS
Dir. V. I. Bune
3 seismic stations
2. SAO
Dir. A. V. Solov'yev
Meteors, upper atmosphere

D. AN, Turkmen SSR

1. AAL Ashkhabad
Stations at Ashkhabad, Khayrabad,
Dushek
Meteors, upper atmosphere
2 seismic stations
2. TAO Tashkent
Dir. V. P. Shcheglov
Kitab International Latitude
Station (KMSHS): variation of
latitude, sun, meteors

E. AN, Uzbek SSR

1. TsSS Samarkand
Seismology

F. AN, Kazakh SSR

1. GAO Alma-Ata
Upper atmosphere, actinometry

II. Main Administration of Hydrometeorological Service (GUGMS)

A. Main Institutes and Observatories

1. GGO (Main Geophysical Observatory), Voyyeykovo, Leningrad
2. NIIZM (Research Institute of Terrestrial Magnetism - Heliophysical Laboratory), Krasnaya Pakhra, Moscow
3. NIIGMP (Research Institute of Hydrometeorological Instrumentation)
4. TaAO (Central Aerological Observatory), Dolgoprudnaya
5. TsIP (Central Institute of Forecasting), Moscow
6. GGI (State Hydrological Institute), Leningrad
7. GOIN (State Oceanographic Institute), Moscow

B. Local Geophysical Observatories (UGMS)

1. AAGU Alma-Ata
2. KGO Kaunas
3. MGO Moscow
4. SGO Sverdlovsk (magnetic observatory at Vysokaya Dubrava)
5. DGO Vladivostok
6. TGO Tbilisi (magnetic observatory at Dusheti)
7. IGO Irkutsk (magnetic observatory at Zuy)
8. TGO Tashkent (magnetic observatory at Keles)
9. KazGO Kazan' (magnetic observatory at Zaymishché)
10. LGO L'vov (magnetic observatory at Yakov)
11. YaGO Yakutsk
12. SGO Srednikansk
13. TBGMI Tbilisi

14. KNIGMI Kazakh (Alma-Ata?)
15. DNIGMI Vladivostok
16. UNIGMI Kiyev (?)

III. Main Administration of the Northern Sea Route (GUSMP)

A. Geophysical Observatories (All aspects of geophysics)

1. Bukhta Tikhaya
2. Chelyuskin
3. Dikson
4. Matochkin Shar
5. Uellen

B. Polar Stations -- Total of 120 (participating in various types of geophysical observations)

IV. Main Administration of Geodesy and Cartography (GUGK)

1. TsNIIGAIK (Central Scientific Research Institute of Geodesy, Photogrammetry, and Cartography)
Gravimetry, variation of latitude and longitude

V. Main Administration of Higher Educational Institutions (GUVUZ)

A. Leningrad University

1. AOLGU (Leningrad Astronomical Observatory)

Sun

2. NIFILGU (Research Institute of Physics)

Upper atmosphere, actinometry,
cosmic rays

3. IZK (Institute of Terrestrial Crust)

Crust of the earth

B. Moscow University

1. GAISH (Sternberg Astronomical Institute)

Sun, variation of latitude, time

C. Gor'kiy University

1. GIFTI (Gor'kiy Institute of Applied Physics)

Radio astronomy

2. NIGShS (Exact name not available)

Variation of latitude

D. Kazan' University

1. KAO (Kazan Astronomical Observatory)

Variation of latitude

2. AOE (Engelhardt Astronomical Observatory)

Variation of latitude, earth
tides, sun, occultations

E. L'vov University

1. IAO (L'vov Astronomical Observatory)

Sun

F. Kiyev University

1. KAO (Kiyev Astronomical Observatory)

Sun

G. Irkutsk University

1. IAO (Irkutsk Astronomical Observatory)

Sun, variation of latitude,
earth tides

H. Tomsk University

1. TAO (Tomsk Astronomical Observatory)

Occultation

2. SFTI (Siberian Physico-Technical Institute)

Ionosphere

I. Ural University

1. AOUGU (Ural Astronomical Observatory)

Sun

VI. Miscellaneous

- A. TsNIIS (Central Institute of Communications, Moscow Ionospheric Station)

Ionosphere

- B. LONIIS (Leningrad Section of TsNIIS) Ionosphere

- C. NIIISKA (Red Army Institute of Communications, Moscow and Leningrad Stations)

Ionosphere

- D. VETAS (Military Electro-Technical Academy of Communications)

Ionosphere