

## History of Tomsk Ionospheric Station Development

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### ABSTRACT

In 1936 regular researchers of the ionosphere started a Ionospheric Station in Tomsk (Russia). By the year 2016 it will be 80 years old. This article is devoted to this remarkable event.

**Keywords:** Tomsk Ionospheric Station, Ionosphere

Tomsk Ionospheric Station was created on June 19, 1936 in the Siberian Physio-Technical Institute (SPTI), Tomsk State University on the initiative of the Academy Of Sciences of the USSR.

On October 2, 1935 professor B.P. Gerasimov, chairman of the commission of Academy Of Sciences of the USSR who is in the preparations of the observations of the solar eclipse 06.19.36 applied to SPTI with a letter which reported on the proposal of Professor M.A. Bonch-Bruevich (Director of the Nizhny Novgorod Radio Laboratory) to observe the impact of solar eclipse on the ionosphere. This appeal was not accidental and is due primarily to the presence of SPTI group of highly qualified specialists who are studying the ionosphere. Another reason was the fact that Tomsk was situated in a place through which the strip of total solar eclipse was coming. Following is the proof of this, the first shortwave station in Siberia worked in Tomsk in 1925 with call sign TUS (“Tomsk University, short”). A.B. Sapozhnikov, B.N. Putkov and V.V. Shirkov were the creators of TUS. This station studied the distribution pattern of short waves on the road Nizhny Novgorod-Tomsk.

In 1930, an assistant professor at Tomsk State University was invited by V.N. Kessenikh (professor since 1933) who headed the department of electromagnetic waves and then the department of vibrations at SPTI. In February 1936, a laboratory of radio wave propagation was established within the department with G.M. Berwald as the Head Professor. The laboratory is a part of some famous names like N.D. Bulatov (graduate of the Irkutsk State University), V.G. Denisov, D.A. Ladigin, A.I. Likhachev, B.N. Hitrov, A.B. Sapzhnikov, N.V. Gulyaev, B.N. Purkov, B.I. Hitrov, and TSU students V. Angilekyo, I. Agreev and N. Rudiev. According to the preparations of the reaction to the observations of the ionosphere on the solar eclipse, V.N. Kessenikh offered the collective to decide a number of important scientific and technical tasks including the development of pulse method of radio sounding of the ionosphere.

In December 1935, an agreement was concluded with the USSR Academy of Sciences in which SPTI had to construct a unit to measure the critical frequency of the F2 layer of the ionosphere observed during the eclipse of June 19 1936 and monitor the changes of critical frequencies and variations of heights reflection on the individual fixed frequencies.

The first sessions on the equipment manufactured in the SFTI for getting altitude-frequency characteristics (Ionograms) continued from May 30 to June 14, 1936.

Since 17.00UT (World time), from 14 June to 24 June 1936 continuous cycle of observations of the ionosphere from the photo-detection pulse method was done. During the optical eclipse (152 min) 16 pictures of altitude-frequency characteristics were obtained that gave a reliable picture of the variations of critical frequencies of the F2 layer of the ionosphere. At that time it was an excellent result.

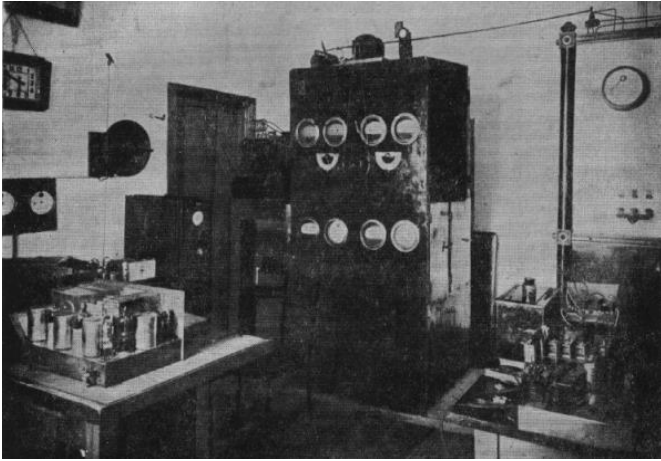
These observations in Tomsk were published in the central press. The most important are the following results:

- 1) Solar eclipse was observed on the background of strong magnetic storm, however, it managed to fix the characteristic variations of critical frequencies of the F2 layer of the ionosphere.
- 2) It was found that the principal agent of ionization of the upper layers of the atmosphere is an ultraviolet radiation from the sun, but not corpuscular one.

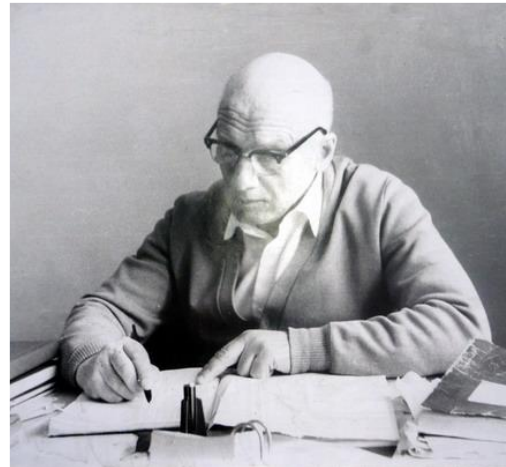
After the observations on the period of solar eclipse, Tomsk Ionospheric Station started its own regular work on the study of the physical state of the ionosphere. June 19, 1936 was the birthday of the station. From that time the ionospheric observations in the USSR (Russia) begins working.

Tomsk Ionospheric Station is the fifth in the world and first in the USSR (Russia). By 1936 these station had already been working in Washington (USA), Slough (England), Huancayo (Peru) and Water (Australia), which were created in the early 30s.

Pioneering works of Tomsk scientists are on high-power pulse in a wide range of frequencies (V.N. Kessenikh, 1936), pairing frequency transmitter and receiver (N.D. Bulatov, 1936), as well as on the interpretation of Ionograms (A. I. Likhachev, 1940) which determined the further ways of development of ionospheric service both in the USSR (Russia) and around the world.



First Tomsk Ionospheric Station



V.N. Kessenikh

N.D. Bulatov offered a way to study the ionosphere using a panoramic automatic station. This method was recognized invention and it took a certificate of authorship with priority from 13.07.36. Methods of N.D. Bulatov allowed to receive ionogram in the range of 5-10 MHz in 3 minutes which did not have the foreign counterparts. So, the first panoramic pulsed ionospheric station of the British Admiralty did not have synchronization of the transmitter and receiver and the time of getting the critical frequency of the F2 layer was 30 minutes. In 1940 A.I. Likhachev, published the first atlas of types ionogram, which became the main working tool of ionospheric morphology. Exactly on their basis all the documents of the international network of ionospheric stations (f-graphs, h-graphs, monthly tables, etc.) are created in our time. In April 1937, Tomsk Ionospheric Station was allocated a separate structural unit, N.D. Bulatov was appointed the manager of the station.

By the summer of 1941 a stage of formation of the ionospheric research in Tomsk ended. In 1940, V.N. Kessenikh successfully completed his doctoral dissertation at Moscow State University.

D.A. Ladigin, A.I. Likhachev and S.P. Tselishev completed their thesis in which they summarized the results of first 5 years of the Tomsk Ionospheric Stations.

On June 22, 1941 the Great Patriotic War began in which N. D. Bulatov, A. I. Likhachev and V. N. Kessenikh were drafted into the Red Army and went to the front. Head of Tomsk Ionospheric Station appointed N. A. Korinevskaya, who has worked in this capacity until 1954 providing continuity during the war. Ionospheric observations in Tomsk were necessary for forecasting the short radio waves in the USSR.

In 1946, after demobilization A.I. Likhachev returned from the army and began working as a senior researcher. In the period 1954-1975 he was the head of the ionospheric laboratory. In 1946 N.A. Korinevskaya completed her thesis [5] in which results of the first 10-year period of Tomsk Ionospheric Stations were compiled.

After the war N.D. Bulatov began working in the Central Research Institute of Communications in the Moscow region (Mytishchi). There he completed his doctoral dissertation and got the title of professor.

Radio-physics faculty of TSU was created at the initiative of V. N. Kessenikh, who returned to Tomsk in 1953. He became the head of the department of radio physics and dean of RPF (Radiophysics faculty). TIS (Tomsk Ionospheric Station) was converted into a laboratory and there were many enterprising young people, students and work begun progressing again.

One of these young men was V.A. Davydov, the coeval with ionospheric research and the oldest active worker of ionospheric service in Russia. He had been working during 5 generations of Ionosondes. Contribution of A.V. Davydov in the study of the ionosphere is recognized by the International Union of Geodesy and Geophysics (IUGG), as well as the American Geophysical Union (AUG).

In 1957 a new serial automatic ionospheric station (AIS-56) was established which has been working in Tomsk for almost 40 years (until January 1996).



V.A. Davydov behind work on AIS-56

On the basis of Tomsk Ionospheric Stations a lot of other experimental researches were developed. Ionospheric scattering was studied and the methods of diversity were improved. In 1958, variational and the absolute measurement of the geomagnetic field measurements were initiated. The methods of processing and the provision of ionospheric parameters continued improving.

In 1971 work started on ionospheric modeling and the organizer of these works A.G. Kolesnik in 1974 became a candidate and then a professor, doctor of science. From 1985 to 2012 he was a scientific director at the Tomsk Ionospheric Station.

In the period of 1975-2000 Y. E. Tarashchuk managed the Ionospheric laboratory. During this period, Tomsk Ionospheric Station was included in the Federal Anagraph of unique experimental settings (1994). With the support of Ministry of industry and the Russian Federal Property Fund the first generation of digital ionosonde «Sail» (February 1996) was purchased and put into operation and with the active help of S. A. Kolesnik translating archive of ionospheric data started (since 1936) from paper to digital form submission. Thus Tomsk's electronic database in ionospheric station for all period of its work begun.

In 1995, the ionospheric laboratory was reorganized into the sector of ionospheric monitoring. Since April 2000, candidate of science B.B. Tsybikov became head of the sector.

For all the period of work of Tomsk Ionospheric Station V.N. Kessenikh (1940), A.I. Likhachev (1965), A.G. Kolesnik (1984) and J.E. Tarashchuk (1991) became doctors of science and 27 candidates were prepared.

I.A. Golikov after finishing graduate school and completing his doctoral dissertation became the Minister of Education of Yakutia (Yakutsk). There he completed his doctoral dissertation and received the title of professor.

Today at Tomsk State University a scientific school for the physics of ionosphere was created. Its founder is considered to be a doctor of physical and mathematical sciences, professor, Honored Scientist of the RSFSR (Russian Soviet Federative socialist republic) V. N. Kessenikh. During the 75th anniversary of ionospheric researches, outstanding achievements of V. N. Kessenikh were immortalized with the memorable plaque on the façade of the main building of SPTI (Siberian Physical Technical Institute).



N. D. Bulatov



N. A. Korinevskaya



A. I. Likhachev



A.G. Kolesnik



Y. E. Tarashchuk



B.B. Tsybikov

In 2006, Research and Education Center "Physics of the ionosphere and the electromagnetic environment" and the Center for collective use with the same name were created on the basis of Tomsk Ionospheric Station, the Department of Space Physics and Ecology RFF TSU, and laboratory space geophysics and ecology SPTI

In March 2008, a new generation of digital Ionosonde, Dynazonde-21 (manufacture USA: Scion Associates Inc .; R. Livingston and Dynasonde Solutions Ltd.; J. Wright, N. Zabotin) was put into operation whose registration was made on the eight-channel phased array antenna.

Dynazonde is a common name of a unique ideology of ionospheric radio sounding which began developing about four decades ago in the organization of the precursor of modern NOAA (National Oceanic and Atmospheric Administration) in Boulder, Colorado, then known as the Institute for Telecommunication Sciences and Aeronomy [6]. Unique features of this ideology are:

- Very little interference to other users of the radio spectrum.
- Careful attitude to physical properties of the raw data in the course of their treatment. Natural physical object - radio echo - is a fundamental ideology of Dynazonde.
- Statistical and mathematical methods for processing high-level data.

In 2010, S. A. Kolesnik had charge of the work on the creation of the modern Russian Ionosonde. In 2011 Ionosonde "TOMION" was installed and commissioned at Tomsk Ionospheric Stations. This Ionosonde is fully digital system. Ionosonde is a research and carries out a continuous round the clock monitoring of the ionosphere within a timeframe of 15 minutes. The results of processing of ionospheric parameters are presented on the internet sites <http://sosrff.tsu.ru> and <http://tomion.tsu.ru>.

Today Tomsk Ionospheric Station is a part of the Center for collective use "Physics of the ionosphere and the electromagnetic environment" of Tomsk State University. Head of the Department of Space Physics and Ecology, Sergey Kolesnik became director of the Center and scientific director in the ionospheric station Tomsk in 2012. Joint Use Center provides timely information about the state of the ionosphere in the Roshydromet of the Russian Federation and world Geophysical Data Center (NGDC). Today in the NGDC there is a uniform and long-period number of observations provided by the Tomsk Ionospheric Stations.



S.A. Kolesnik

Currently Tomsk Ionospheric Station successfully continues to maintain and develop the traditions established by its founders and their disciples [1,2]. Experimental basis is improving. Scientific and educational work and training of highly qualified personnel is conducted. Tomsk Ionospheric Station is integrated into a local network of Tomsk State University with Internet access. The results of operational processing of current data are available in the organization of the Roshydromet and the World Data Centre. Also they are available for Internet users. In 2005, the work on the creation of an electronic database for the period 1936-2004 was completed. This database continues growing with the current data and a remote access system is developed and implemented.

#### **ACKNOWLEDGMENTS**

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