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GENERAL ADMINISTRATION  
OF GEODESY AND CARTOGRAPHY  
UNDER COUNCIL OF MINISTERS OF THE USSR



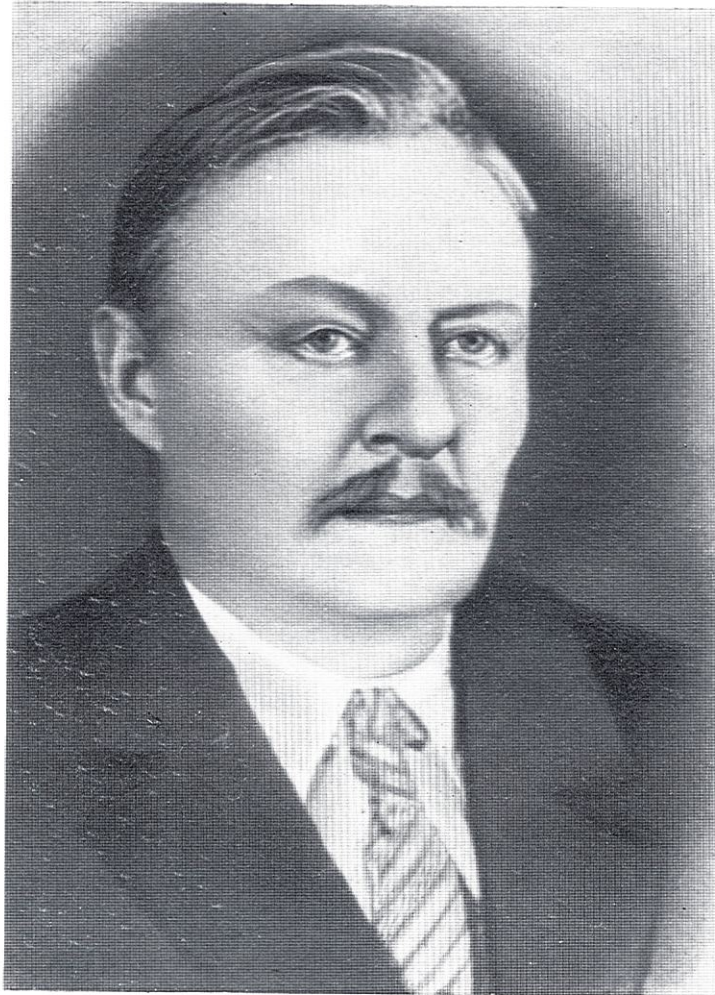
CENTRAL RESEARCH INSTITUTE  
OF GEODESY, AIR SURVEY  
AND CARTOGRAPHY  
(GNIGAik)

MOSCOW 1976

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*Professor F.N.Krasovski*

Výzkumný ústav geologický, topografický  
a kartografický v Praze  
Knihovna

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The Central Research Institute of Geodesy, Air survey and Cartography (CNIIGAiK) was established in 1928. Its first Director and scientific leader was the celebrated soviet scientist and geodesist, Professor F. N. Krasovski (1878—1948).

At that time the Institute was the only specialized research establishment in the field of geodesy and cartography in the USSR. The science researches and investigations of the newly-established Institute were aimed at the solution of problems of geodetic control extension and providing topographic maps for the USSR territory. That work was surmounted for the development of the national economy, utilization of natural resources and socialist construction.

In the very earliest years of its existence, the activities, sponsored by the Institute, were directed towards development of scientifically-based schemes and programmes of expanding National Geodetic Control network in the country. This ambitious problem was successfully solved. The dimensions of the Earth figure were determined under the direct supervision of F. N. Krasovski in 1940. That work was based on an extensive utilization of degree measurement and gravimetric data. As a result of these investigations, a sophisticated reference ellipsoid, named after Krasovski, was recommended as reference datum for all geodetic measurements in the USSR.

Up to the present the latest geodetic activities, sponsored by both Soviet and foreign organizations, including those using artificial satellites, have proved the validity and correctness of conclusions, made by F. N. Krasovski.

The foundation-laying programme of expansion of triangulation control, pioneered by Krasovski, was performed by numerous soviet geodesists. In the years of the first five-year-plan periods (1930—40), when extensive construction of the new industrial centres was started, when the agriculture was reorganized, and the roads were vigorously expanded,—the geodesy surveyors determined tens of thousands of geodetic points, they run many thousands kilometers of levelling lines. An experiment adjustment of the first class triangulation network was started as early as 1931. The general adjustment of the National Geodetic network of the USSR, referenced to the Krasovski's datum, took nearly five years and was completed in 1945. The country and the national economy were contributed by a reliable reference datum for further extension of surveys and compilation of sophisticated and exact maps.

The mapping requirements for development of the national economy, utilization of natural resources were fully comprehended even in the first years of industrialization of the country (1928—1932). Even at that time the Geodetic service of the country was tried to replace the unproductive plane-table surveying by the new air survey methods. But to solve this problem at that time meant to build the home-made air cameras, processing equipment and to work out concepts and methods of survey. It was necessary to train new specialists on airphotography. The foundation of CNIIGAiK and reorganization of training in the Moscow Geodetic Institute (now Moscow Institute of Geodesy, Airphoto survey and Cartography) and opening of a number of technical training centres answered these purposes.

The scientists of the Institute jointly with the scientists of a number of research establishments and production enterprises in the period of 1930—60 carried out progressive investigations and researches. The inculcation of those accommodated the immense influx of needs of national economy in topographic maps and geodetic data.

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In 1930th and 1940th the methods of airphotosurvey were worked out. They were applicable to variable geographic conditions of the country. Home-made air cameras and stereoplotters were built, amongst which a memorable role was played by Professor Drobyshev's stereometer. Its application in surveying shortened the time, required for mapping in 1:100 000 scale the whole of the country, and boosted the production of large-scale maps for the most important economical regions of the country.

The exceptional efficiency of the air survey was surmounted by the use of wide-angle and super-wide angle cameras. The first in the world wide-angle air camera objective with  $100^\circ$  vision angle was elaborated in 1934. In 1940 a super-wide-angle objective with  $120^\circ$  angle of vision was elaborated.

The scientists of the Institute and the technicians of the Optic Mechanical Plant designed and built automatic air cameras with focal lengths of 70, 100, 140, 200 and 350 mm. Such a wide range of air cameras is accounted for the different physical-geographical conditions of the country in compilation of topographic maps of different purposes and of variable accuracies.

Based on dynamic developments in the field of radioelectronics and in automatics in our country, the gyrostabilizers for air cameras were built, thus, the airphotographs with small inclination angles were originated. Precise statoscopes for determination of differences of heights in airphotosurvey were designed, as well as topographical radio altimeters, for determination of altitudes of air photographs. The introduction of the above instruments into air survey imparted a considerable decrease in the labour-consuming field work, attached to the air survey.

The investigations in the field of air survey prompted recommendations on expedient conditions of photographing to impart the best image.

The scientifically-based specifications of photomaterials and light filters, the expedient methods of photoprocessing were patterned, thus increasing the efficiency of photointerpretation.

The fundamental theoretical studies by soviet scientists and photogrammetrists: M. D. Konshin, G. V. Romanovski, A. S. Skiridov, A. N. Urmaev, F. V. Drobyshev, A. N. Lobanov, G. P. Jukov imparted progressive photogrammetric instruments, theories, concepts and techniques of formation of a stereomodel with various focal lengths, and theory of space phototriangulation.

When a new task was set—to compile maps scaled 1:25 000, in the Institute, under the supervision of Professor Drobyshev, the universal stereo photogrammetric instrument—stereograph was designed and introduced into production. The stereograph enables to process air photographs with different focal lengths.

At the same time different techniques of photogrammetric control extension were imparted; those were based on the above mentioned theoretical studies.

The extensive work was carried out to expedite modernization of 1:100 000 map content. Under the supervision of scientists-cartographers, a number of fundamental soviet cartographic works was compiled. Amongst those were „Great Soviet World Atlas“, „Geographical Atlas for school teachers“, „Atlas of USSR Agriculture“ and others.

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#### MODERN TRENDS OF RESEARCHES AT THE INSTITUTE.

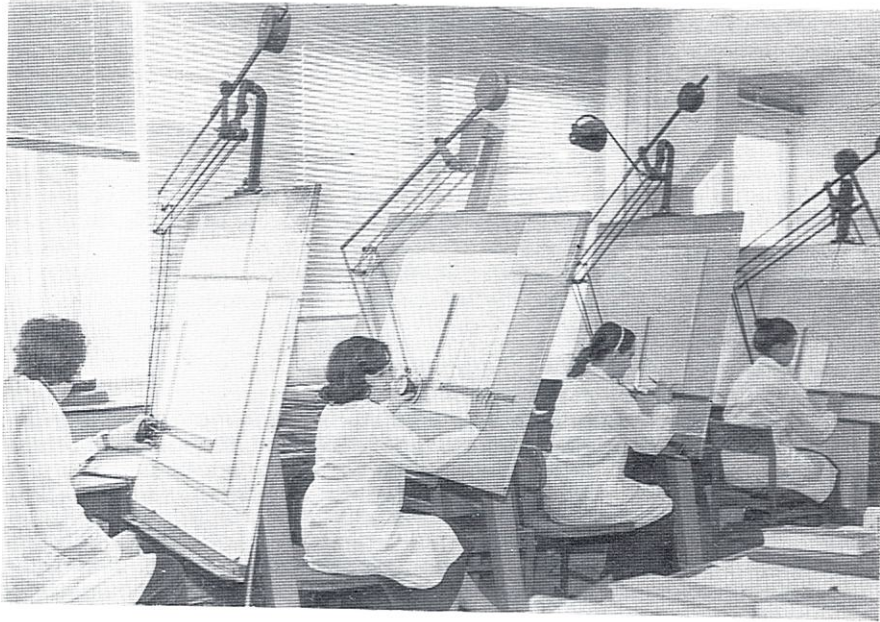
Due to the vast increase of surveying and mapping work in the country, those mostly being large-scale surveys in towns and areas of extensive industrial construction, or land irrigation, the Institute faced new problems of development of even more sophisticated techniques and concepts of survey.

There have appeared new and wider ways of invention of modern instruments and techniques, based on vigorous progress of science and home industry in the field of radioelectronics, automatics, optics, and computers. The Institute designs and introduces new efficient geodetic, gravimetric, photogrammetric and cartographic instruments and techniques, aimed at radical perfection of surveying and mapping, vigorous increase in labour productivity, and cutting down expences.

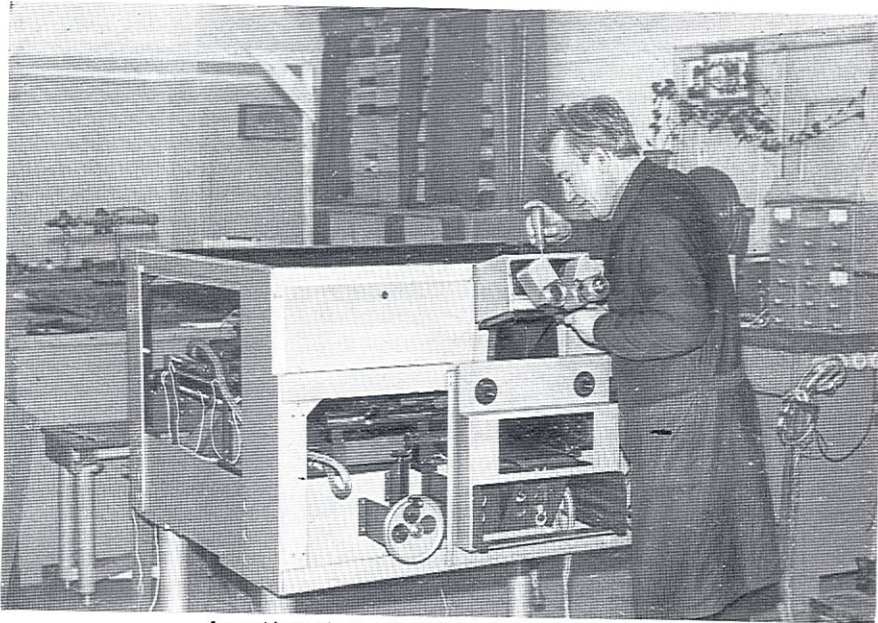
The main sections of the Institute were broadened and supplied with a new laboratory equipment for geodetic, photogrammetric and cartographic studies. New laboratories were organized, such as those of radioelectronics, optics, mathematical adjustments with the use of computers, mapping of the Moon and other planets. Relations of the Institute with other scientific bodies and production enterprises vastly expanded, thus complex scientific investigations were started, and the results of those were rapidly introduced into practice.

There are different types of measuring equipment and apparatuses, modern computers at the Institute. There is an Optical Mechanical Plant,

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*Design office*



*Assembling of the new photogrammetric instrument*

producing experimental models of instruments. Apparatuses and instruments, invented by scientists and designers of the Institute, and built at the Experimental Plant, are tested and examined at special polygone site and in production enterprises. After that they are handed over to optical-mechanical factories for serial production.

At service of scientific workers of the Institute there is a science-technical library, counting more then 75 thousand volumes of literature, necessary for science researches and investigations. There is a fund of patents and descriptions of inventions, catalogues and card-indices of inquiry-information fund of science-technical information section.

#### INVESTIGATIONS IN THE FIELD OF GEODESY AND GRAVIMETRY.

Science research work in the field of geodesy, initiated by the Institute at a time of its foundation, is at present carried out in a vigorously expanded field. Scientists-geodesists are proceeding with investigations of the shape, dimensions and gravity field of the Earth by astro-geodetic, gravimetric and artificial satellite data.

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Urged by requirements of building up control for large-scale surveys, a special attention is paid to elaboration of instruments and techniques for geodetic control densification, short distance measurements, and elevation determination for surveys under different geographic conditions.

Investigations are carried out on the problems of vast astro-geodetic control expansion, continuous triangulation nets of high accuracy measurements, I and II orders levelling network build up.

The scientists of the Institute participated in compilation of the „Map of Earth Contemporary Crust movements of Eastern Europe“, collaborating with scientists of a number of socialist countries. At the same time with design of the new instruments for angular and linear measurements, standardization of geodetic instruments is being done.

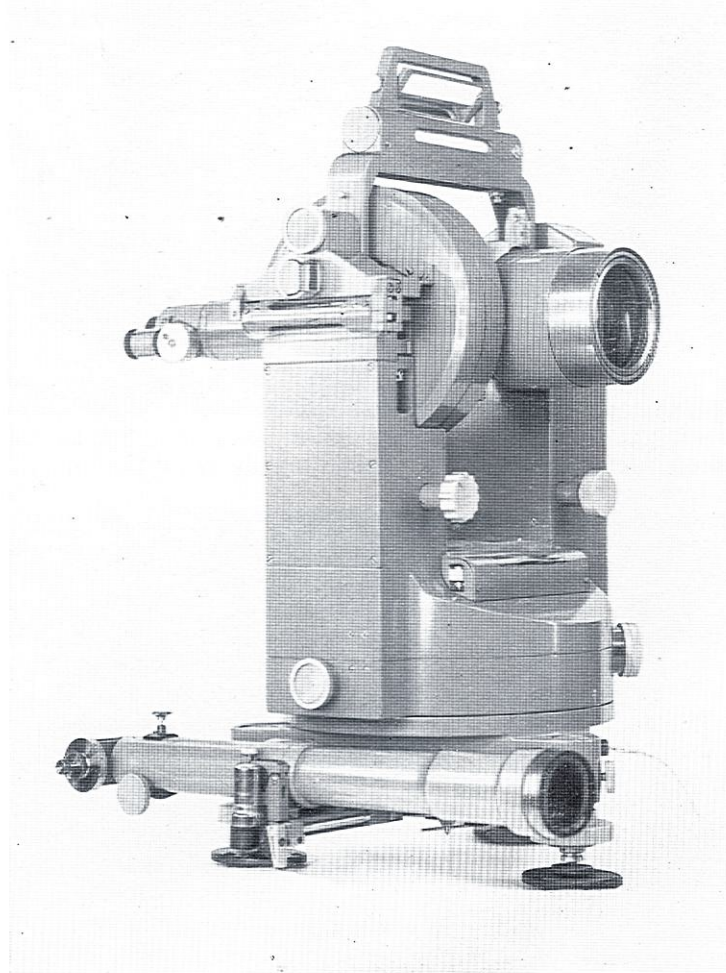
The national standards worked out at the Institute, are introduced into practice and they stipulate manufacture and application of the instruments for diverse geodetic work, meeting the legitimate requirements for quality.

An optical theodolite T-05 was devised at the Institute for angular measurements. It allows to measure the angles with error not more then  $\pm 0,5$ . For the high accuracy of linear measurements electro-optical range-finder „Quartz“ was designed. It is equipped with lazer light source. A radio phase range-finder „Luch“ worked out by the Institute with close collaboration with organizations of optical-mechanical industry is widely used in various geodetic survey projects. A considerable increase of accuracy in line measurements by this radio range-finder is attributed to the use of three cm-wave band carrying frequency. Besides, a provision is made to rise the aerial of the transmitter-receiver sets up to 25 m, thus there is no need to build geodetic towers.



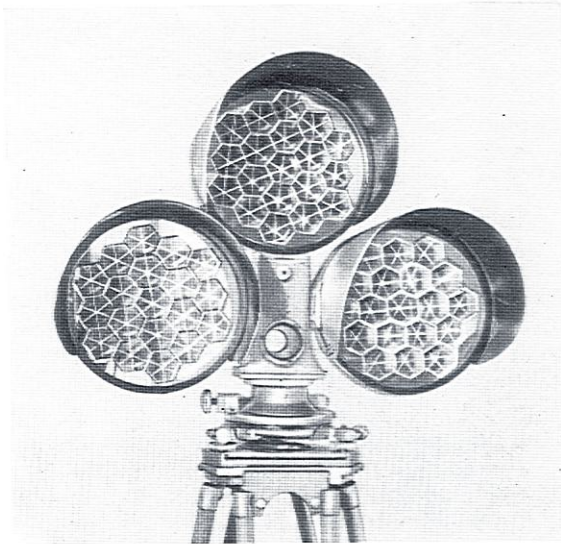
There are vacuum pendulum apparatuses OVM and pendulum complexes „Agat“ built in the Institute to be used in high precision measurements of the 1st order gravimetric control points and of base-lines for calibration of gravimeters.

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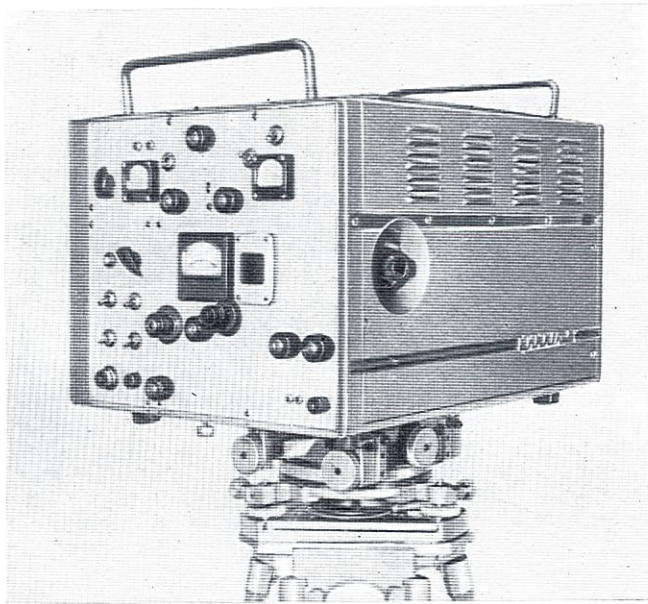


*Theodolite T-05*

For relative gravity measurements aboard a ship while gravimetric survey in high sea or shelf aquatories there is a pendulum apparatus AMP. It consists of pendulum on a cardan suspension, a figure-pointer, a control panel, and a set of batteries.



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*Electrooptical range-finder „Quartz“*

## INVESTIGATIONS IN THE THE FIELD OF AIR PHOTO TOPOGRAPHY

Investigations in the field of air photo topography are advented at intensive elaboration of concepts and techniques increasing productivity of large-scale surveys, mainly by reduction of labour-consuming field survey work. In view of this new automatic air cameras with high resolution and level of correction to match that were designed to expedite improvement of accuracy and quality of air photo. Investigations are carried out, which result in design of sophisticated automatic universal instruments for processing of aerial photos with different focal lengths, with large reduction factor, and with provisions allowing to consider the errors of air photos caused by lens distortions, film deformations and film unflattening. To reduce the amount of field surveys, airborne radio range-finders were designed for precise positioning of the air photo projection centres, as well as for determination of altitude of aircraft.

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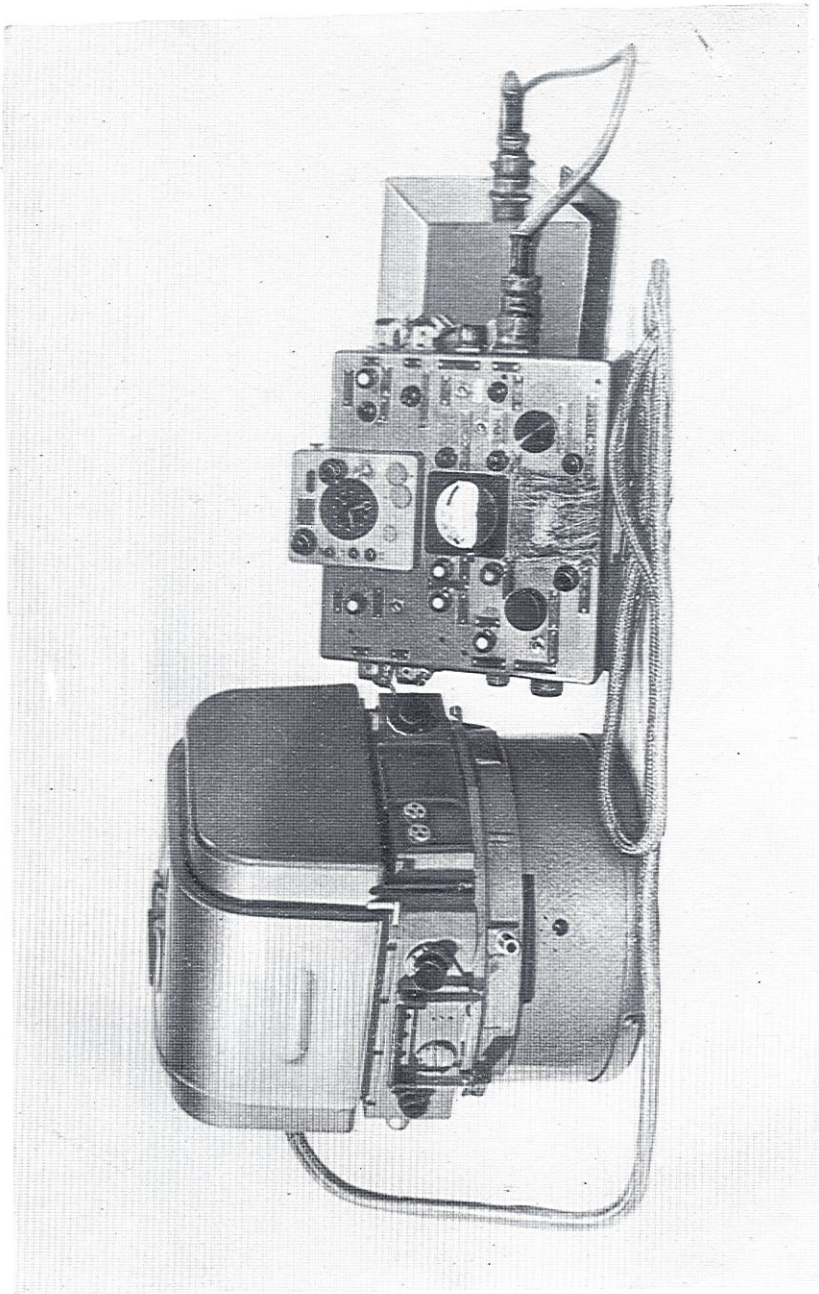
Modern air cameras with focal lengths 50, 70, 100, and 350 mm were designed at the Institute and introduced into production. These cameras were equipped with Russar objectives (designed by Professor Rusinov), with very short exposure time locks. The air cameras, produced by home industry, are set aboard modern soviet survey aircrafts, such as AN-30.

To compile the originals of maps on a large scale, a universal instrument SC was designed. The ratio factor of scale of image to the scale of map is as big as 6 times. The technical potentialities inherent in the instrument, make it possible to compile maps by air photos, the scale of those being two times as small as the scale of images for plotting by the previously used SD-3.

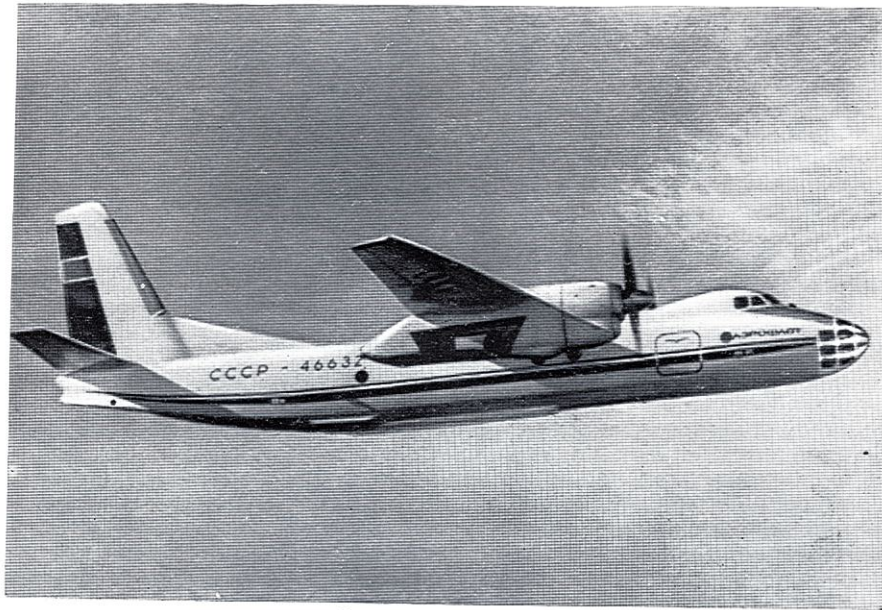
An air photo rectifier for making photoplans of hilly areas was designed and introduced into production. It allows to rectify the photos with focal lengths from 50 to 500 mm with elevations in stereo model up to 35% of the altitude of flight. To precisely identify the same points on different images and various strips, a stereo marking instrument NT was constructed. It is intended for work with images sized from 18×18 cm to 30×30 cm, with smooth alteration of observational system to 50 ×.

Further investigations in the field of photogrammetric instruments are aimed at designing analogo-analytical universal plotters with provisions to correct errors of air images.

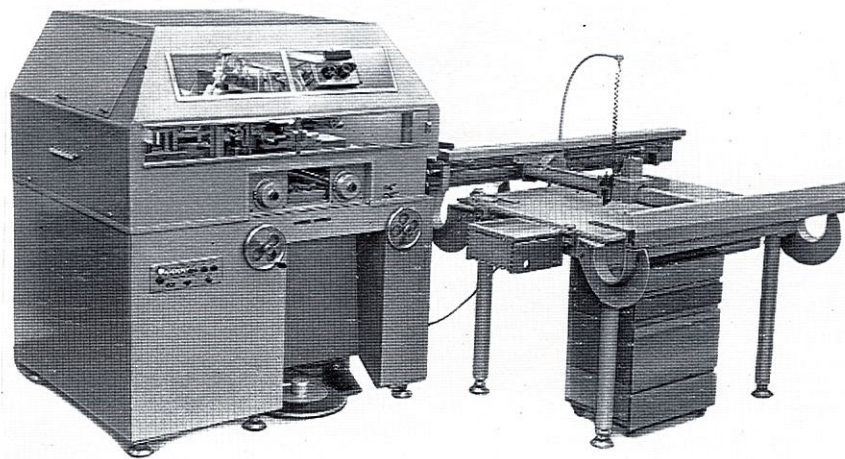
Airborne radio range-finders were designed and built at the Institute. They boosted to a new level the efficiency of air survey and geodetic survey. The apparatus measures distances between the aircraft and two ground stations with high accuracy. In remote areas of the country this apparatus is used for building up horizontal control for topographic surveys.



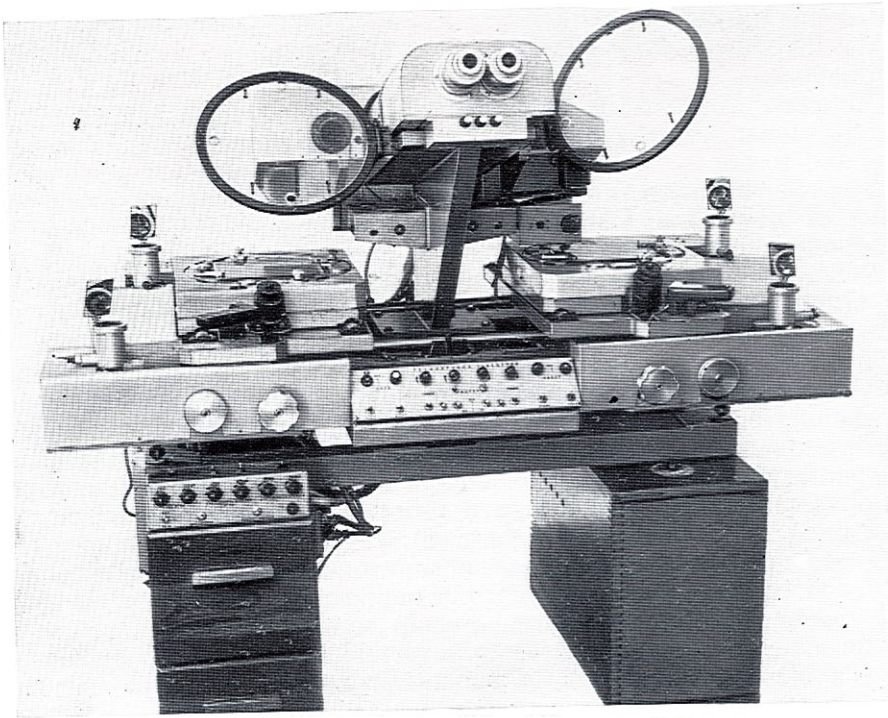
*Air camera TES-7*



*Survey aircraft AN-30*



*Stereoplotter SC*



*Stereomarker NT*

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### INVESTIGATIONS IN THE FIELD OF CARTOGRAPHY

In the field of the development of thematic cartography the scientists of the Institute paid their attention mainly to the improvement of existing and to working out new methods and concepts of compilation of specialized thematic maps.

To meet the ever increasing demands of the National economy for different cartographic sources the Institute in collaboration with a number of other organizations is carrying out scientific works along the following main trends:

- the study of modern status and requirements of the national economy to specialized thematic maps of various scales;
- elaboration of the main statute of compilation of the specialized thematic maps to regulate the activities of different departments and organizations in the field of projecting, editing, compilation, designing and publication of the above maps.

New types of maps and atlases and new methods of compilation are elaborated. The Institute participated in preparation of the following atlases: „Physical-Geographical Atlas of the World“, „Atlas of Agricul-

ture of the USSR", „Atlas of Antarctica" and so on. The cartographers of the Institute are preparing methodical handbook for thematic map compilation.

Unification and standardization of the following features of the maps is being done: scales, projections, arranging, figurative means and design, and so on.

A special attention of the Institute and a number of other scientific bodies of the country is paid to the development of the educational cartography. One of the main results of this work is elaboration and constant modernization of system of soviet educational maps and atlases. The printing technique of the educational maps, atlases and other types of cartographic training appliances is continually improved.

To further increase the labour productivity and to reduce the time, required for map production, a new technique of map compilation and preparation for printing by scribing on a coating of transparent film was developed, and a number of scribing instruments and devices were designed at the Institute, in collaboration with other research and production organizations. The designed set of scribing instruments is applied for scribing of all the linear features of maps, New technical means are developed to promote mechanization and automatization of map compilation and preparation of maps for printing.

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A number of new techniques for map printing with the use of polymeric materials to prolong the time of map wear out, to promote the strength of map sheet and to substitute expensive and rare natural materials for polymeres, were worked out by the Institute in collaboration with map printing factories.

A new technique of preparation for printing and map printing is elaborated and introduced into production. The idea is to print multi-coloured maps in 4—6 inks only, using the concept of photomechanical and electronic colour separation. It reduces the number of printing inks 2—3 times, increases labour productivity and promotes the quality of multi-coloured maps.

In the field of geographic names standardization and cartographic science-technical information, the investigations are directed along two main trends: standardization of geographic names and information on cartographic sources and objects of cartography for the interested organizations. The first trend is characterized by:

- study of primary geographic names gathering in the field while surveying and working out the necessary methods;
- geographical name catalogue compilation;
- investigation on elaboration of concepts and rules of Russian transliteration of geographic names of peoples of the USSR and of foreign countries;
- elaboration of methods and compilation of dictionaries of geographic names.

The Institute publishes surveying manuals for geographic names gathering and transliteration dictionaries of national geographic terms,

obligatory instructions for Russian transliteration of geographic names of the USSR and foreign countries, dictionaries of geographic names of the USSR and foreign countries.

The second trend is aimed at elaboration of computerized storage-retrieval system for information on cartographic sources and objects of mapping.

Topographic and cartographic studies of the Moon, Mars, Venus and other planets are performed at the Institute now. There are theoretic and scientific investigations on photogrammetric and cartographic processing of space photographs, calculation of coordinates of control points of space photographs; map compilation of planets in various scales and for different purposes.

#### INVESTIGATIONS IN THE FIELD OF ECONOMY AND EFFICIENT ORGANIZATION OF SURVEYS.

During the last years the scope of science-research work in the field of economy and efficient organization of surveying and mapping were vastly expanded. There are researches aimed at elaboration of automatic management systems and at introduction of computers.

Theoretical problems and concepts of planning, prices and production quotas are worked out to facilitate the progressive development of the survey branch and to guarantee the industrial technical-economical policy in the country in the field of surveying and mapping.

Investigations are carried out to improve methods of labour quotation and material-technical quotas in surveying and mapping, to develop methods of determination of labour productivity, systems of payment for labour quotas. Much attention is paid to evaluation of science-research work efficiency, as well as to efficiency of investments and introduction of new technique in surveying and mapping.



