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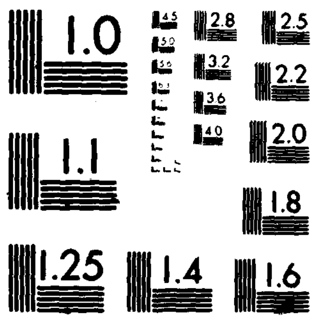

MICROCOPY RESOLUTION TEST CHART

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FOREIGN TECHNOLOGY DIVISION

METEOROLOGICAL SATELLITES

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METEOROLOGICAL SATELLITES

The Soviet radio broadcast interesting information about USSR meteorological satellites and space weather service problems.

Television cameras located on board of one meteorological satellite can transmit in less than two hours the picture of a 100 million square kilometer surface (5 times the area of the USSR). Aircraft (airborne photography laboratories) would have to fly over 2000 hours for this purpose.

Two types of information satellites are presently operational in the Soviet Union: Meteor-2 (second generation meteorological satellite) and an experimental satellite on which instruments are being tested and modified for the requirements of hydrometeorology and a determination of natural resources.

Television devices with a 1-10 km terrain image resolution operating in the visible and infrared region are used to determine the space system, velocity and direction of cloud movements and provide information about the snow and ice cover, cyclones, storms, vortices in the atmosphere, velocity and direction of wind, etc. Images with a 50-1000 m resolution make possible geological and hydrological surveys, an evaluation of the state of vegetation and crops, detection of forest fires, determination of polution of the atmosphere and sea and determination of optimal fishing regions in

the ocean. Measurement of the intensity of radiation in the atmosphere in narrow infrared regions and very high frequencies allows remote evaluation of the temperature and humidity distribution in the vertical cross section of the Earth's atmosphere. The latter is used in weather forecast and climate studies.

First generation Soviet satellites used television cameras with photoconductive pickup tubes. The images were transmitted every minute (for a period up to 10 sec). The altitude of the satellite orbit was 900 km, as a result of which one image could encompass a 500 x 1400 km area. The resolution of the image was 400 lines, i.e. the resolution of details in the terrain was up to 1300 m. After delelopment on ground and mosaic assembly of successive images, a picture of a surface with a 28-30 million square kilometer area was obtained after each orbit of the satellite around Earth. However, photoconductive pickup tubes had certain shortcomings: short service life, they were not suitable for a quantitative analysis of the structure of clouds, autcmated mosaic assembly of photographs and computerized data processing.

Television scanning systems without the enumerated shortcomings were introduced in the USSR in meteorological satellites in 1972. We have already described the scanning principle in the astronautics section of Skrzydlata Polska. Scanning systems are very complicated devices which require, for example, for the acquisition of high resolution infrared data (10-12 micrometers) specially cooled (to 80 to 100 K) receivers. The data system on board meteorological satellites consists of numerous devices, measuring instruments and TV and infrared sensors. It transmits encoded data to so-called simplified ground receiving stations. There are more than 60 such stations in the USSR. Every station can deliver several minutes after the overhead flight of the satellite photographs of an area within approximately a 1300 km radius (about 2% of the Earth's surface).

Simplified recieving stations are located in civil aviation airports, seaports, on large ships, etc. Radio communications

operate directly in the international frequency range and allow data reception from a satellite in more than 500 stations throughout the world. Other radio communications and a magnetic memory system in which data collected during the flight of a satellite (beyond the radio range) from the territory of the USSR are stored also exist. The system stores data from television and very high frequency global observation sensors, a spectrometer, (studies of vertical profiles of the atmosphere) and a wide angle radicmeter (evaluation of the state of Earth's radiation).

Data from the memory of the satellite are subsequently transmitted to regional ground receiving points in the USSR. To reduce radio reception interference these points are situated at a great distance from large cities. From these reception points the data are transmitted by means of radio communication to data processing centers in Moscow, Novosibirsk and Khabarovsk. Part of the data, after decoding and selection, is recorded in the form of negatives and photographs and the other part, after processing in a computer, provides quantitative information. Images from scanning devices are subjected to a thorough photometric analysis and the obtained data are stored in the memory of the computer.

From the large volume of initial data (several hundred million bits) specialists collect data for weather forecasts, drawing of geological maps, detection of forest fires and determination of methods for extinguishing the latter, etc. Other data are used for further reevaluation on computers (this time faster computers with greater computing capabilities).

Meteorological satellites must ensure an exceptionally high stability of the observation zone and resolution of the picture of a surface. The alignment precision of the longitudinal axis of the hull of the satellite with TV cameras and other sensors with respect to the Earth's center and the alignment precision of the transverse axis with respect to the direction of flight is 20 to 30 angular minutes;

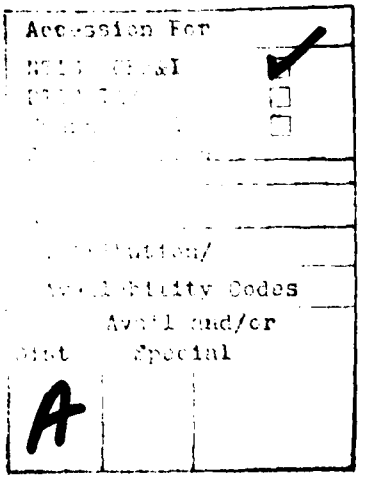
the oscillation rates of the hull within these angular ranges must not exceed 0.005 - 0.01 angular seconds. Satellite electromechanical, active stabilization and orientation systems are used for this purpose.

Meteorological satellites are supplied from solar and chemical batteries. The supply system constitutes 20% of the total mass of the satellite. Radio communications and the programmed timing system are used for controlling equipment on board the satellite (for example switching on standby equipment).

The required service life of a meteorological satellite is at least 2-3 years.

Present day rocket technology is not yet capable of launching meteorological satellites directly into the required exactly determined orbits, therefore they must be equipped with vernier engines. Light electrojet motors are used for generating thrust as a result of the acceleration of charged particle fluxes and utilization of the electric field. Testing of these engines on the Meteor satellite simplified their control and improved the quality of collected meteorological data.

The use of meteorological satellites over many years has demonstrated that they are a safe and indispensible means for solving many problems in the USSR national economy.



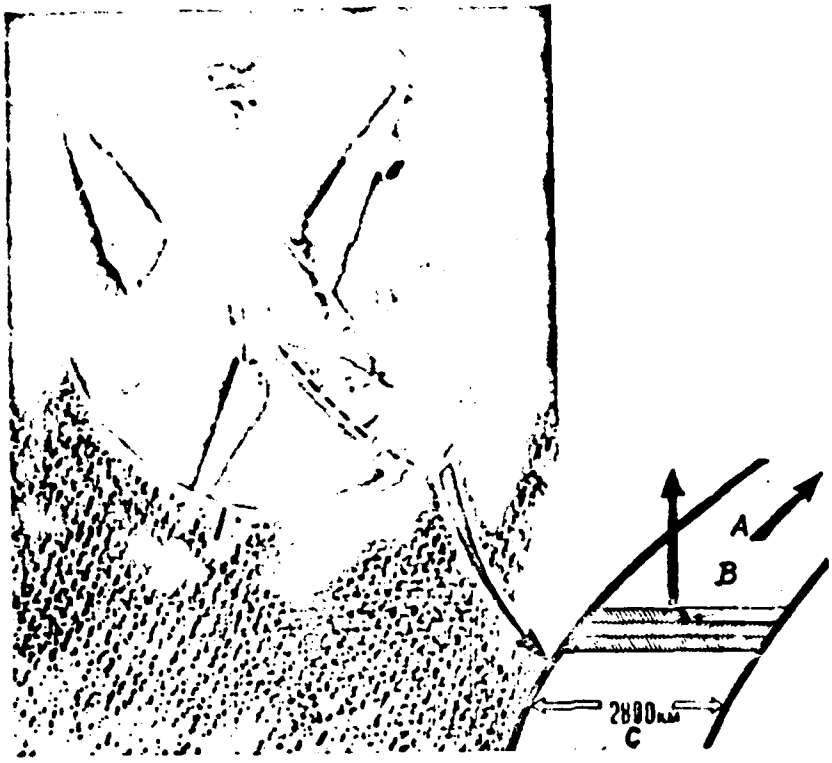
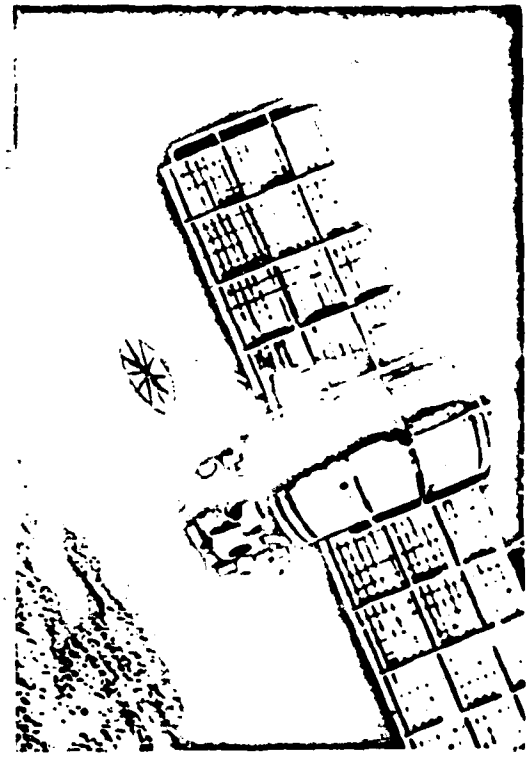
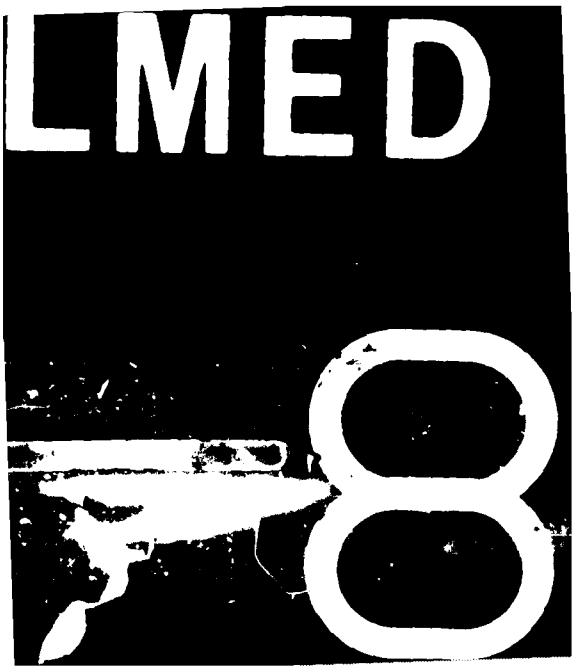


Fig. 1. Operational principle of goestationary metorological satellites. Line encompassing globe denotes the equator (drawing on left).
A - Direction of fligh of meteorological satellite. B-Field of view of instruments on board the satellite. The image of Earth or the cloud cover, reflected by a mirror arrives in the lens and the in the filter and modulator from where it a-rives (via specially cooled receivers) to amplifiers, the encoding and data compression system. From there data are transmitted via radio or directly via the computer, transmitter and antenna to ground centers or also indirectly via memory unit on board the satellite. C-Satellite observation zone (width 2800 km).

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