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PROTON -3

SPATIAL SUPER-LAB

by

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(BELGIUM)

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P R O T O N - 3

SPATIAL SUPER-LABORATORY

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by Germain Ajoux

SUMMARY

This article describes the powerful carrier rocket, third of the scientific stations of the series "PROTON", launched in the Soviet Union on 6 July 1966 and placed into a circumterrestrial orbit with 630 km in apogee and 190 km in apogee. This probe has a total payload in orbit of 12.2 tons.

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The scientific program of the spatial automatic stations of the "Proton" type involves a series of fundamental problems of very high-energy cosmic rays.

The apparatus installed on-board Proton-3 is designed for the study of solar cosmic rays and of the danger they present in regard to radiation hazards. This instrumentation allows moreover the study of the energy spectrum and the chemical composition of particles in the range of energies reaching 100,000 billion electronvolts, of nuclear interactions between cosmic particles of very high energies, reaching 1000 billion ev, the determination of the absolute intensity and of the energy spectrum of galactic electrons and of gamma-rays, having energies exceeding 50 million ev.

One may wonder what is the reason to indulge in such a research deep in space?

When penetrating into the terrestrial atmosphere, primary cosmic rays of very high energies hit the nuclei of atoms constituting them and are thus being absorbed. This is why the energy of particles of these cosmic rays reaches the ground so weakened, even in mountains, that it is practically impossible to utilize them for precise quantitative studies.

If, to the contrary, these studies are performed in the extra-tarrestrial space where the energetic power of these particles is hundreds of thousand times higher than at sea level, it becomes possible to study their behavior. Whence an obvious advantage to have recourse to satellites for this kind of studies.

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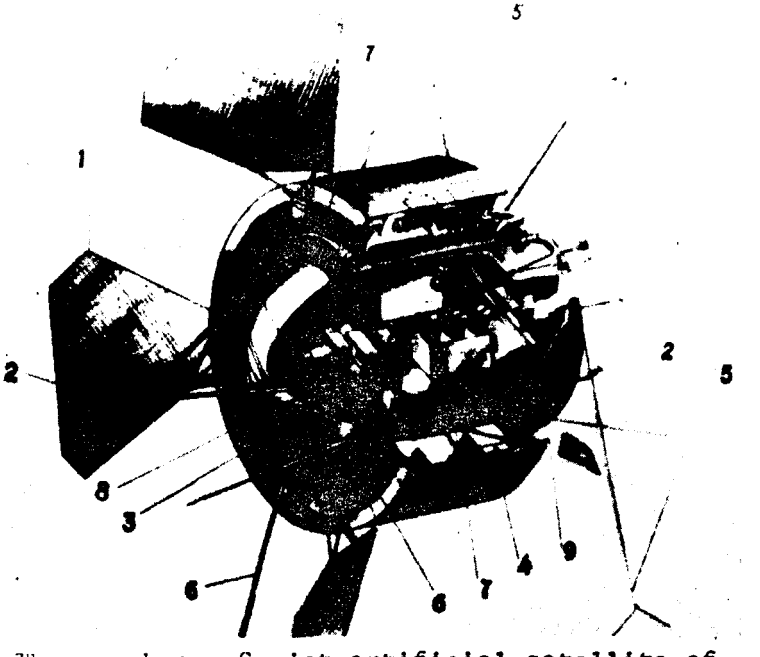
* PROTON 3 SUPER-LABO SPATIAL

Thus, as was stated to us by the Soviet Academician V. Gintzburg, before the experiments carried out with the aid of satellites only protons were found in solar cosmic rays. It had then appeared probable, that by their chemical composition solar cosmic rays differed considerably from the galactic cosmic rays. However, analysis of the data collected by Russian as well as American satellites has shown that it is not so and that there exist in solar cosmic rays different nuclei also.

Do we have to recall that the famous Van Allen radiation belts were also discovered thanks to artificial satellites ?



The new heavy Soviet artificial satellite of the "PROTON" type: 1) spectrometer for cosmic ray particles of moderate energy; 2) gamma-telescope; 3) to 8) instrumentation of the ionization calorimeter; 9) device registering high-energy electrons

A COMPLEX AUTOMATIC LABORATORY

In order to study particles of cosmic rays of high and very high energy it is necessary to determine amongst the multitude of particles reaching the station Proton, those having the highest energies, that is, the energy of each particle must be measured first of all. To that effect Soviet physicists have conceived a very original method, resorting to a device called "ionization calorimeter".

As reported by the review "Soviet Studies"* the ionization calorimeter is composed of numerous steel plates, between which scintillators, made of a special plastic material, are placed. When a very high-energy particle reaches the calorimeter, it hits the nuclei of iron atoms. The impact gives birth to a series

* "Etudes Sovietiques"

of secondary particles, which, hitting in their turn the iron nuclei, engender particles of the following line, and so forth. Finally, the whole energy of the primary particle is transmitted to a large number of secondary particles which will be absorbed by the thick frame of calorimeter's material.

The absorption of energy is attended by a brief glow in the scintillators, glow of intensity proportional to the energy absorbed in the ionization calorimeter, that is, to the energy of the primary particle. These glows are registered by electronic photomultipliers.

Two special counters, each proceeding on its own to measure the electrical charge of particles, have been placed above the calorimeter with the view of studying the nature of cosmic ray particles.

Above each counter there are, over one half of the apparatus, a block of graphite, and over the second half a block of polyethylene. The object of this researches involves the interaction of high-energy particles with the matter composing these blocks.

The polethylene block consists of carbon and hydrogen atoms. Thus, in one half of the appa atus studies bear on particle interaction with the carbon and hydrogen atoms' nuclei, and in the other with the nuclei of carbon atoms. The comparison of the results of measurements carried out in both compartments of the apparatus allows to determine with great accuracy the interaction with the nuceli of hydrogen atoms, that is, with protons.

A scintillation counter is placed under the calorimeter. It determines, alongside with an interaction detector, the particles moving in a specific direction.

THIS "TWELVE TONS" IN ORBIT

Amongst the duties incumbent to the scientific apparatuses of the station we should call attention to the registration of gamma-quanta of primary cosmic radiation, the study of intensity variations of cosmic rays, etc.

At present, the scientific apparatus operates normally and executes the program foressen.

Besides the scientific instrumentation, Proton-3 is equipped with an apparatus for telemetric measurements, trajectory measurements, and with a system indicating the station's position in space; it has, moreover, programming aggregates, a damping device system, a piloting remote control apparatus, sources of electric power and a system of thermic regulation.

To avoid exceesive heating or cooling the frame of the station is protected from outside by a thermic insulation of proven efficiency, as reported by the editorial of "Études Sovietiques". The required temperature and pressure are maintained inside.

The hermetic body of the station is a cylinder with convex bottom. The various scientific devices, the telemetry and the system of position indication are located inside in the central and rear parts of the body.

Fastened outside the body are the solar cells and the sensors designed to indicate the station's position. At the rear bottom there are located the electro-pneumatic stabilizer blocks with the compressed gas cylinders, the gas pipes and the commanding devices, and a retractable radiation heat exchanger. On the frame itself are fixed the antennas of the telemetry aggregate, of the remote control guidance and of the system for trajectory measurements.

Finally, there are located between the external envelope and the body of the station a series of capsules containing the chemical batteries.

It is presumed that the investigations carried out by Proton-3 will allow a great step forward in the domain of space physics.

***** THE END *****

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