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MAJOR LANDMARK IN THE INVESTIGATION OF OUTER SPACE

Press Conference

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MAJOR LANDMARK IN THE INVESTIGATION OF OUTER SPACE

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Highlights of the Press-Conference
devoted to the
First Soviet Artificial Satellite of the Moon

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SUMMARY

This press-conference was held in the Moscow House of Scientists on 16 April 1966. It was presided by Academician M. V. Keldysh, who opened the Conference by reviewing all the Russian feats since 1959. Most of it is repetition of what was reported many times, and will be omitted in this report.

Concerning the AMS Luna-10, the chairman stressed the requirements for an AMS to achieve the lunar orbit, which are less in the way of braking impulse than for landing, thus allowing a substantial payload increase. Because of the absence of atmosphere on the Moon, the study of numerous properties of its surface can be achieved by registration of γ-, X-, fluorescent and infrared radiations. Important data on the Moon's gravitational field will be obtained from the observation of AMS orbit evolution. The first results obtained and the description of the instrumentation aboard Luna-10 are briefly reviewed. All this was previosuly reported by Tass (see ST-PR-LPS-10474).

More detailed data on lunar ground are then given in a statement by academician A. P. Vinogradov; it will be present here as a full text.

Professor N. L. Grigorov then delivers a report on the magnetic field, the ionosphere and the radiation. This also will be presented here in full length.

Academician A. A. Mikhaylov, the well known astronomer concludes with a few considerations as to what "neighbor" really is.

The press-conference closed with a question-answer period, of which the highlights will be given below

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FIRST INFORMATION ON LUNAR GROUND

by

A. P. Vinogradov

The determination of radioactive formations constituting the surface of the Moon offers an exceptional interest from many viewpoints.

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*) KRUPNAYA VEKHA V ISSLEDOVANII KOSMOSA
Headline on page 3 of the newspaper "PRAVDA" No.107 (17424), 17 April 1966
A Tass Communique.

First of all it is important for the solution of a series of problems linked with the origin and the evolution of the Moon. Their solution is impossible without the knowledge of the chemical composition and the radioactivity of lunar formations.

The investigation of Moon's radioactivity offers also interest in a different aspect. Because of absence of atmosphere the cosmic radiation reaches its surface freely. At cosmic ray interaction with the lunar formation nuclear reactions set in. That is why the existence of cosmic ray-induced radioactivity, practically absent on Earth because of the shielding effect of its atmosphere, is to be expected on the Moon. The investigation of such a radioactivity provides the possibility of making a series of conclusions of interest as regards the intensity, the energetic composition of cosmic rays near the Moon and their intensity variations in the past, and also the effects induced by solar flare-generated radiation and so forth.

Finally, the study of the intensity and of the spectral composition of γ— radiation provides an important information from the standpoint of practical mastering of the Moon on the radiational setup on its surface.

As geochemist I shall touch upon the geochemical aspects of results obtained by Luna-10 at further length.

The radioactivity of terrestrial rocks is determined by finding in them radioactive elements, that is, uranium, thorium and potassium-40. The granite, broadly spread over continents, constitute the most radioactive formations. The basalts, forming on our planet a continuous basaltic layer in the Earth's crust, contain approximately 10 times less radioactive elements than the granite. It is well known that basalts emerged as a result of planet's primary matter splitting under the action of radiogenic heat, this matter being in its composition close to stone meteorites, and subdivided into basalts and ultra-basic rocks. Being more fusible, the basalts were melted out on the Earth's surface. The ultra-basic rocks, which as a rule lie beyond the limits of the Earth's crust and belong to the Earth's mantle or to the Earth's transitional layer, contain about 100 times less radioactive elements than the basalts. By their uranium, thorium, and potassium-40 content, the stone meteorites join the ultra-basic rocks.

Therefore, granite, basalts, ultra-basic rocks and stone meteorites while differing by their properties and chemical composition, do so also by their content in radioactive elements. In other words, the determination

of the quantity of radioactive elements of uranium, thorium and potassium-40 in the rocks gives at the same time a representation on the type of these rocks.

Most diversified representations on the character of lunar rocks now prevail, It is thus assumed, for example, that the rocks covering the surface of the Moon probably suggest crystalline rocks of the Earth's crust. On the other hand, there exists also the opinion that the Moon's surface is partly composed of remains of coarse meteoritic bodies having fallen on the Moon in a very remote past, imparting to it the characteristics of ultra-basic meteoritic matter, and so forth. The range of similar representations is quite broad.

The experiment, set up with the aid of Luna-10, has at first supplied the scientists with an exclusively interesting experimental material on the direct determination of the character of radioactive lunar rocks.

According to preliminary estimates, the content in natural radio-active elements in lunar rocks lies within the range of Earth's basaltic rocks.

We would not wish to derive braoder conclusions as yet and prefer to accumulate and process the enormous material arriving from Luna-10. However, even now one is led unwillingly to conclude that, apparently, the crust formation processes for the planets of the Earth's group have one and the same mechanism.

The micrometeoric setup in the near-lunar space is also being investi-gated with the probe Luna-10.

From 3 to 8 April the instrumentation for the registration of meteoric particles in the near-lunar orbit was exposed in the course of several sessions with a total time of 5 hours 16 minutes. During that time 53 meteor particle impacts were registered. If we take the average number of impacts per square meter per second for the exposure time, it will exceed by about 100 times the mean number of impacts in the interplanetary space.

It is premature to derive at present any conclusions concerning the observed events. To judge as to whether or not the Moon passes through a cluster analogous to those observed in the interplanetary space, or that such a cluster is a "Moon's belonging" is something that will be feasible later, after obtaining additional data and accumulating further the experi-mental material.

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MAGNETIC FIELD, IONOSPHERE, RADIATION

by
N. L. Grigorov

The physical characteristics of the near-lunar space are only partly defined by the physical peculiarities of the Moon itself. To the measured parameters of the near-lunar space a substantial contribution is made not only by the Sun, but also, in a series of cases, the Earth. For example, the magnetic fields in the vicinity of the Moon may constitute the sum of magnetic fields of the Moon, of solar corpuscular streams and of the geomagnetic field.

It is natural that, under the circumstances, the separation of the physical characteristics of the near-lunar space, conditioned by the Moon itself, is beset with considerable experimental difficulties.

In order to separate reliably the characteristics of the near-lunar space of specifically lunar origin, it is necessary to conduct investigations at various periods of solar activity and at different positions of the Sun, the Earth and the Moon.

The study of the near-lunar space conducted in 1959 with the aid of Luna-2 has shown that, provided it exists, the magnetic field of the Moon does not exceed 50 gammas; that the steady level of trapped radiation, provided the latter exists, is at least 1000 times lower than the radiation level in the terrestrial radiation belts. Thus was established, to quote physicists, the upper boundary of possible values for a series of most important parameters defining the properties of the near-lunar space.

In order to progress further in these investigations it is necessary to apply a more sensitive scientific apparatus than that used previously.

Measurements of the magnetic field of the Moon were begun on 3 April after Luna-10 was put into the near-lunar orbit. The readings of all the three channels of its magnetometer clearly revealed the presence of a feeble uniform and regular magnetic field. According to the results of preliminary processing, during the 3 April session the field intensity module constituted 14 gammas, on April 5 it was 24 gammas, on April 8 — 18 to 36 gammas. On 9 April there was observed a field with mean value of intensity at 17 gammas.

When comparing the observed values of magnetic field intensity from 3 to 9 April with the changes in the position of the Moon relative to the

line Earth - Sun, one can not avoid paying attention to the fact that the Moon - Earth - Sun angle was nearly 180° during the period between 5 and 6 April, when the maximum field value was observed in the most prolonged radiocommunication session.

The weak magnetic field observed in the vicinity of the Moon during fullmoon period may be induced by three different causes, as was already mentioned earlier. It may be the Moon's proper magnetic field, an interplanetary magnetic field of solar origin, and it may also be the tail of the Earth's magnetosphere.

Bearing in mind the quiescent state of the indicated period, the observed slow variation of the magnetic field value from day to day is possibly linked with the variation in the position of the Moon relative to the line Sun — Earth. Such a character of magnetic field variation should be expected if the "tail" of the Earth's magnetosphere reaches the orbit of the Moon. The role of the magnetosphere tail may be defined more precisely when measuring the magnetic field in the new moon period.

It is well known that the Moon has no dense atmosphere, but the existence at the Moon of a very rarefied atmosphere is not excluded. If the Moon has an atmosphere, the atoms of the lunar atmosphere, ionized by the solar radiation, must form a lunar ionosphere. That is why particular attention was given those experiments of Luna-10 which could resolve the question of the existence of lunar ionosphere.

With the view of direct measurements of the density of ions in the near-lunar space a modulation-type charged particle trap was installed on Luna-10, which allows to measure the positive ions with energies < 10 ev.

The examination of the results of measurements leads to the preliminary conclusion that ion fluxes of low energies are registered along the orbit of the AMS.

Two four-electrode traps allowing to measure the total flux of ions with energies > 50 ev were also installed on Luna-10.

The search for the Moon's ionosphere was also conducted by the method consisting in the study of radiosignal character variation when Luna-10 orbits behind the Moon. The observation of radiosetting behind the Moon was conducted on 8 April. The power level of the received radiosignal

was registered by a special instrumentation. The process of radiosignal power decrease at setting and its increase at station's Luna-10 emergence from behind the Moon was clearly registered by a self-recording device. The processing of the readings obtained has shown that the law of signal level decrease and increase corresponds to the case of radiowave diffraction over the sharp edge of the lunar surface without noticeable distortions that would have been observed in case of the presence near the Moon of a notable gas medium, either absorbing or refracting the radiowaves.

For the study of the radiation setup in the vicinity of the Moon two charged particle counters were installed aboard Luna-10.

The study of the weakly-penetrating radiation has shown that during the period when the Moon was in the new moon phase between 5 and 6 April, the level of this radiation was minimum. Then, as the Moon emerged from the assumed Earth's magnetosphere "tail", the radiation intensity rose and reached its highest value on 9 April. At the same time, the counting rate exceeded the background level, conditioned by cosmic ray particles, by 10 - 20 times.

If we view the radiation level registered on 5 and 6 April as due to trapped radiation, assuming the existence of a Moon's radiation belt stationary in time, the intensity of particles in it will be 100 000 times less than in the Earth's radiation belts.

In the measurements conducted for determining the various physical parameters, one fact is striking: the magnetic field intensity, the concentration of positive ions and the radiation intensity were all found to be dependent on the position of the Moon relative to the line Sun - Earth. It is possible that in the course of further analysis of the entire aggregate of data obtained it will be possible to ascertain the inner relationship between these events.

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WHAT IS OUR COSMIC NEIGHBOR LIKE?

by
A. A. Mikhaylov
Astronomer

The launching of an AMS has an enormous scientific value. Artificial satellites of the Moon, equipped with an appropriate apparatus, may provide precise information on numerous heretofore entirely unknown or still insufficiently known properties of the Moon and of the surrounding space. Here are referred the investigations of Moon's temperature regime, its possible volcanic activity, the meteor concentration, the magnetic field of the Moon, its proper radiation and the reflecting properties in infrared and far ultraviolet rays, the direct photographing and the television transmission of Moon's surface images etc.

Of particular importance is the circumstance that the satellite's orbit plane has a 72° inclination to the lunar equatorial plane. The fact is that the satellite's orbit plane maintains in space an invariable direction, while inside the orbit the Moon rotates, executing a revolution around its axis in the course of the lunar month of 27.3 days. Because of that, the satellite shifts after each revolution by 1.6° along the lunar longitude. In the course of a month the satellite passes twice above every spot of the lunar surface.

But aside from physical investigations the very existence of the satellite in the orbit is of extreme importance. Radiotechnical measurements of the motion parameters of AMS allow the obtaining of the most valuable data. Before anything else the mass of the Moon will be known more precisely, or, to express it better, the Earth to Moon mass ratio, which at present is assumed to be equal to 81.30. Another interesting question is the position of the mass center of the Moon itself. The investigation of Moon's motion around the Earth has shown that the mass center does not coincide with the center of the visible disk of the Moon. but is displaced by about one kilometer to the North of the disk's center. Subsequently, the scientist spoke of the value of the AMS for making more precise its shape.

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The scientists then answered a series of questions asked by Soviet and foreign newspapermen.

After that the scientists answered a series of questions asked by Soviet and foreign newspapermen, of which the following are the most pertinent :

— What are the main factors upon which the precision in bringing the satellite into orbit depends ? What system — the ground or the airborne plays a decisive role in such a precise experiment ?

— Answer (by Acad. Keldysh) : This precision depends on the extent it is possible to get nearer the computed motion when bringing the probe to the path toward the Moon. It is not possible at this time to achieve a precisely computed motion at time of launching. Thus the precision depends on the extent we may be able to determine the trajectory by radio and automatic means and on what degree of precision may be attained in correcting that trajectory in flight. It is difficult to say which instrumentation, the ground or the airborne, is more important. Both are indispensable, both are decisive and both are sufficiently complex.

— How many photographic cameras on Luna-10 : A : None. It may be stated that Luna-10 is designed for physical investigations of the Moon and of the near-Earth and near-lunar space. Cameras may indeed be installed on such a satellite, but at this time it was not anticipated.

— Why no attempt was made to carry out photographing ? Many scientists estimate that photos from lunar orbit are required for selecting a practical landing point ?

— A: If and when this becomes necessary we dispose of an instrument for performing such photographing of the Moon. At the moment we consider the main problem to constitute those scientific problems which are being resolved by Luna-10.

— Q: What is the lifetime of the AMS ?

— A: It will last several years. The precise determination of lifetime cannot now be made, for to that effect we should know exactly the Moon's gravitational field. But Luna-10 is precisely designed to determine the latter in particular. We may however state that it will exist at least a few years; however, the time of active operation will be less.

— Q : Do you feel that the astronaut's flight to the Moon will require additional training by comparison, for example, with the calculated for the emergence in the open space ?

— A : Most likely so, for if the astronaut reaches the Moon, he will wish to emerge on its surface. There the conditions will be rather unusual, since the gravitational pull on the Moon is approxiametly six times less than on Earth. Thus cosmonauts must get accustomed to the change, and they must necessarily wear special outfittings since the radiation effects there are much stronger than on Earth, being coupled with other radiations. Radiation shielding is thus prerequisite.

— Q : What should those entrusted with erecting space laboratories have for qualifications ? Has their preparation begun ?

— A : It was already said in our press-conferences that the assembly of spaceships in orbit is one of the promising means to create space probes for further cosmic flights. Naturally, our astronauts are being prepared for the solution of these problems.

— Q : American scientists plan to launch a series of AMS in 1966-67, to have them flown over the landing region of Luna-9 and photograph it. Does the photographing of the landing region of Luna-9 offer really a scientific interest ?

— A : Obviously, this is interesting. If such photographs could be made we would be interested to have a look at them. As to the scientific aspects of the question, the interest is doubtful.

— Q : Can anything further be said about the processing of data from Luna-9 ?

— A : I may state that further analysis of photographs was made. Since the photographs were made from various levels and at different illuminations, we are now in a position to appraise the surface of the Moon. We now may obtain something of the nature of stereoscopic images. The photos are being analyzed, particularly from the standpoint of geological properties of the surface, and this provides the possibility for new judgments on its character and composition.

— Q : Which result of experiments with Venus-2 and Venus-3 is most significant ?

—A : I feel that the most significant fact is that the probe flew to another planet, thus making it a great advancement for space navigation.

At the same time these probes carried out numerous measurements of physical properties of interplanetary space. We know at present that there takes place in it a stormy life of inanimate matter. It is of extreme importance to be aware of these processes both, for the knowledge of the properties of outer space and Sun's action, and for the development of astronautics.

— Q : Has the Co os-110 experiment confirmed that men may safely go beyond radiation belts ?

— A : Cosmos-110 was the first satellite with living beings having been in radiation belts for a prolonged time.- No accidents occurred; however, a long study will still be required to determine the subsequent effects. These results will be published in due time.

— Q : Will the Luna-10 trajectory be utilized for manned spaceship flight to the Moon ? How should a station be equipped if it to return to Earth after flight around the Moon ?

— A : I think that if manned flights to the Moon are to be implemented the results of Luna-9 and Luna-10 will in any case have a great significance. Those indeed are the essential steps in the development of space engineering which provide the solution of many a problem of flights to other planets.

— Q : Is the consummation of Luna-10 flight being planned ? How long will it remain in orbit ?

— A : From now on no ballistic operations of any kind are planned for Luna-10 The satellite shall remain in the gravitational field of the Moon, and, obviously, partly in those of the Earth and the Sun. As to its active sojourn and existence, determined by feed sources, it is difficult to say. This depends on how often we shall carry out radiocommunication sessions. At any rate it will be in term of months.

— Q : Could spaceships Vostok and Voskhod fly under radiation level conditions revealed in the near-lunar space ?

— A : I think they could. But it must be stated that radiation exists not only around the Moon, but also in interplanetary space. It may increase at times as a function of solar activity. This requires further study.

— Q : How should a probe, designed to return to Earth after flight around the Moon, be equipped ?

— A : It must in the first place have engines for return journey; secondly, it must have an instrumentation assuring the extremely important and complex problem of reentry into the terrestrial atmosphere for a space

ship, approaching it at the second cosmic velocity.

Some of the newspapermen's questions were also answered by A. P. Vinogradov.

*** THE END ***

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Errata/1

Please take note of the following correction to be made :

			instead of	read
page 2	para 5	line 24	:::: 10% less...	.... 10 <u>times</u> less

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25 April 1966