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SOLID COMPONENT OF INTERPLANETARY MATTER FROM VEHICLE OBSERVATIONS

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Abstract. This paper contains the data of meteoric particle investigations by means of piezoelectric detectors.

The data obtained on the different Soviet vehicles at distances from about 100 km to about 100000000 km from the earth are given.

Measurements have demonstrated that apart from fluxes there are individual aggregations of meteoric particles with very unequal spatial density of particles in them. Linear dimensions varied within wide limits.

A concept of the mass spectrum of meteoric particles is presented.

Very high concentrations of minute dust particles were observed near the earth at altitudes from 100–200 km by means of ground-based methods and rocket measurements.

The increased density of interplanetary matter in the vicinity of the moon during April and May 1966 was recorded by means of satellite Luna-10. By means of Luna-12 it could not be discovered whether this aggregation is the moon halo or is the result of the moon passage through some dust particle aggregation, because the investigation on satellite Luna-12 was carried out mostly during meteor showers.

Meteoritic material in the solar system consists of many solid bodies varying in diameter from a few microns to a few kilometres. They become visible for the ground observer only if, after penetrating into the earth's atmosphere, they produce luminiscence and ionization effects. Investigations of meteoritic particles by optical and radar methods, as well as by collecting and analysing meteoritic bodies precipitated to the earth, have enabled us to make thorough studies of meteoritic material. On the basis of observations of meteoritic bodies made at the moment of their encounter with the earth, it has become possible to determine the velocity vector, the mass, density, composition and spatial density of particles with masses $m > 10^{-4}$ g. Analysing these data, one can evaluate meteoritic material in interplanetary space.

Until recently, as far as particles with lower masses are concerned, it was feasible on the basis of photometric study of zodiacal light and the F-component of the solar corona, to obtain only integral characteristics of particles and their density in interplanetary space. Extrapolation of data characterizing particles with masses $m > 10^{-4}$ g to particles of smaller size is not correct in all cases, in particular, when we deal with the character of variations of particle number with a decrease in their mass.

With the advent of rockets and artificial earth satellites it has become feasible to record individual particles with masses of up to 10^{-15} g in the vicinity of the earth and in interplanetary space, and to determine the character of their distribution in space, as well as to determine the physical and chemical properties of the particles collected at heights of 100 km above the earth's surface. Artificial moon satellites

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have enabled us to explore space near the moon, and particularly the concentration of interplanetary material in it.

By now, rocket and satellite data have been obtained regarding the spatial density of meteoric particles with masses of 10^{-7}–10^{-15} g, a concept of the mass spectrum of these particles has been obtained as well as the first data on their velocities. In recent years very difficult experiments have been initiated on obtaining samples of meteoric particles directly from high altitudes.

While designing automatic recording instrumentation for exploring meteoritic material from rockets and satellites, use was made of physical phenomena which accompany the impact of a meteoritic body against the barrier. Various sensors have been designed which enable us to determine the spatial density of meteoritic particles along flight trajectories of space vehicles from the recorded rate of particle impacts against the sensors' sensitive surface, as well as to define some physical characteristics [1].

It was pointed out recently that the use of acoustical sensors involves serious drawbacks. As these sensors are widely used in flights, it is necessary to consider this criticism and to determine the degree of reliability of measurements carried out by means of acoustical sensors. Acoustical sensors are subject to the influence of temperature gradients and this results in many false signals. Sensor calibration involves many uncertainties and consequently, the mass spectrum obtained from these measurements may be incorrect. It is probable that acoustical sensors give false signals under the effect of the 'dust atmosphere' of a space probe or satellite.

After the publication of NILSSON's [2] paper on the influence of low-temperature gradients on his acoustical sensors similar experiments were conducted in the U.S.S.R. and the U.S.A. Earlier, our acoustical sensors were tested with regard to the influence of temperature in a large temperature range. Recently, we have conducted laboratory investigations of the effect of real temperature gradients (which any space vehicle has in flight) on our sensors. Our detectors were tested in the temperature interval from 50 °C below zero to 100 °C above zero with positive or negative temperature gradients from 0.02 to 0.5° per minute, as it was in flights. In addition, the influence of positive or negative gradients of the order of a few degrees was tested.

Experiments have demonstrated that, under the effect of temperature gradients, the sensor did not give false signals. The analysis of the data of our flights also confirms the lack of a correlation between the temperature gradients and the number of signals given by the sensors. So we have no reason to doubt our experimental data. But we do not rule out the possibility of the existence of some sort of single signal caused by an unknown source without changing the final result, if one takes into account the accuracy of the space-density estimates which are available. Negative results of the influence of temperature gradients on ceramic sensors used in eleven American flight experiments on the basis of laboratory tests and analysis of flight data were reported by BOHN *et al.* [3].

Let us now turn to the problem of sensor calibration.

When a meteoritic particle moving at a velocity of about 5 km/sec (with respect to a satellite) impacts a barrier – a measuring device –, it bursts and the impulse of the sensor material ejected during the explosion considerably exceeds that of the particle itself. Measuring this 'reactive' impulse sensed by the measuring device, it is possible to obtain some function of the mass and velocity of a meteoritic particle.

A theoretical calculation by STANYUKOVICH [4] has shown that, for high velocities, the recorded impulse I is proportional to E, the energy of a particle.

The $I \sim E$ law is not recognized by everybody. LAVRENTYEV [5] assumes that $J \sim mv^{1,6}$, where m and v are the mass and velocity of particle. While analysing the experimental results in the U.S.A., KONSTANTINOV *et al.* [6] in the U.S.S.R. have proceeded from the law $J \sim mv$. Recently BOHN *et al.* [7] have obtained experimentally for ceramic sensors the dependence $S \sim mv^{\alpha}$, where $\alpha \geqslant 2$ ($V_{\text{particles}} > 5$ km sec^{-1}).

We have used the law $J \sim E$ in interpreting our experimental data.

Since, in deciphering data, a velocity value should be assumed, we naturally obtain only an idea of the mass spectrum, and in this sense the criticism concerning acoustical sensors is justified.

The last note concerns the possibility of recording the 'dust atmosphere' of a rocket or a satellite by acoustical sensors. The particles constituting the dust atmosphere of a space vehicle have very low velocities with respect to it (of the order of centimetres per second). Acoustical sensors can record them if the particles of the vehicle 'atmosphere' have large masses. However, it is difficult to imagine that there will be so many such large particles causing false signals and that they will be able to follow the vehicle during a very long period of time (up to a few months) causing false registrations not uniform in time, sometimes with long intervals of about several weeks.

Hence, we regard the data we have obtained by means of acoustical sensors as sufficiently reliable as well as all rechecked U.S.A. experiments, in which sensors of such type were used and experiments conducted by Dr. Wlochowicz.

There is much experimental data, received by means of different sensors.

While considering them it should be kept in mind that different methods of recording particles are based on different physical phenomena which accompany the impact of fast flying meteoritic particles against an obstacle, and this may lead to some differences in the final results. In our opinion, this is a probable reason for the disagreement of data obtained by acoustical methods and methods based on penetration of a meteoric body in the obstacle. Of course, when comparing of experimental data one should take into account the distances at which the experiment was performed as well as the conditions under which it was made, and the values of sensitive areas of detectors.

As mentioned above, interpreting our experimental data we have used the dependence as $J \sim (mv^2)/2$, where m and v are the mass and velocity of a particle.

During the analysis of the results of our first measurements the velocity of a particle was assumed to be 40 km/sec. The conclusion made by WHIPPLE [8] that the velocity of the encounter of meteoric particles with a satellite is about 15 km/sec, was very convincing and well-grounded. Therefore, the results of the first experiments have been recalculated in all subsequent papers and since 1961 the velocity of a particle's encounter with a satellite has been assumed to be 15 km/sec.

Table I sums up our results of investigating meteoritic particles from rockets and satellites [9], [10]. For all experiments the sensitive areas S (effective areas for geophysical rockets), the time of the instrument operation t, the impact rate and the altitude are given. In experiments with geophysical rockets instrumentation has been tested. The impact rate of meteoritic particles recorded in these experiments contains some uncertainty (the uncertainty factor is about 3), there is the uncertainty in the estimate of sensitivity of detectors too. A large amount of data was obtained at altitudes of 60–150 km for particles with masses 10^{-15} to 10^{-11} g (mainly in the U.S.A.).

In our opinion, during analyzing, the experimental data at altitudes of about 100–200 km should be considered separately from other data.

At such altitudes both ground-based methods (analysis of brightness of the twilight sky) and rocket measurements have shown a very high concentration of minute dust particles, mainly with small velocities. These particles form the dust halo of the earth. We have not been able to observe the earth's dust cloud at the distance – predicted in theory – of thousands of kilometres from its surface, this may be on the account of its very low density.

While considering the problem of the spatial density of meteoritic bodies at larger distances from the earth, the earth itself and its artificial satellite should be considered a specific probe which moves in interplanetary space and encounters meteoritic showers, individual aggregations and sporadic meteoric bodies. Thus, at great altitudes fluctuations of spatial density of meteoritic bodies are mainly observed which reflect the picture of meteoric-matter distribution in space (the earth's dust envelope, of course, is also subjected to fluctuations but somewhat differently due to the presence of the dense atmosphere).

Measurements of the Soviet satellites Electron-2 and Electron-4 may serve as an example of this. These satellites were equipped with identical meteoritic instrumentation and were placed into similar orbits (the apogee is about 4000 km, the perigee is about 400 km), but they operated at different times.

From January 30 to March 10, 1964, for a total operating time of about 479 hours, Electron-2 recorded three aggregations of meteoric particles, with intervals between them of a few days, as well as four particles, also with great intervals between them [15].

The linear dimensions of the aggregations reached 3000000 to 5000000 km. The first of them recorded on January 30–31, 1964, was sufficiently dense to enable us to determine the direction of its motion.

For about 15 hours 185 impacts were recorded. The orbital impact distribution has made it possible to separate a part of the orbit where only three impacts occurred out of these 185 impacts. Such a distribution of impacts is feasible in the case when the earth passes the aggregation of meteoritic particles (similar to crossing the flux). In this case, with the appropriate angle between the plane of the satellite orbit and the vector velocity of the aggregation, the larger or smaller portion of the satellite orbit is shielded by the earth.

A geometric consideration of the problem has shown that in the given case this angle is about 36°, while the angle between the directions of the aggregation velocity vector and the earth's velocity vector is about 42°.

Assuming that the aggregation had a velocity of 42 km/sec, which is the maximum for the earth's distance from the sun, the average relative velocity or the encounter of meteoritic particles with the sensors was about 61 km/sec. In this case the average impact rate per square meter per second was 1.1×10^{-1}.

To evaluate the masses of recorded particles we have used, as in our previous papers, the following ratio between the pulse I received by the sensor, the mass m and the velocity v of a particle: $I \sim (mv^2)/2$, assuming that $v = 61$ km/sec.

Up to March 10, 1964, i.e., before instrumentation ceased to function, two more aggregations of meteoritic particles were observed on February 11–13 and on February 23–25. Since during this time a small impact rate was recorded (in one case 10, and in the other 24) we were unable to determine the possible directions of the motion of the aggregations and for estimates of the mass of particles a velocity of 15 km/sec was assumed, as is usually done by us for sporadic meteoritic particles.

The recorded impact rate for particles with masses 6.5×10^{-8} g$\geqslant m \geqslant 2 \times 10^{-8}$ g per square meter per second was in these cases the following $N_2 = 2.4 \times 10^{-3}$ and $N_3 = 5.8 \times 10^{-3}$.

From February 29 to March 10, four additional impacts of meteoritic particles were recorded, among them two for about 22 hours from February 29 to March 1, and two on March 5, for about 14 hours.

In total 223 particles were recorded during 479 hours.

$$N_{\text{aver.}} = 7.5 \times 10^{-4} \text{ imp m}^{-2} \text{ sec}^{-1}.$$

From July 11 to September 1, 1964, Electron-4 recorded only nine particle impacts for 898 hours, the time between them varying approximately from a day to a week:

$$N_{\text{aver.}} = 10^{-4} \text{ imp m}^{-2} \text{ sec}^{-1}.$$

The influence of showers and aggregations (or unknown showers) on the particle concentration in the neighbourhood of the earth was detected from observations on Sputnik-3 when a particle density increase by approximately orders of magnitude was recorded. The influence of showers was shown also by DUBIN *et al.* [16] from data gained from Vanguard-3 when, under the influence of the Leonide shower, the particle concentration increased approximately by 2 orders of magnitude. The increase of particle concentration by 2 orders of magnitude under the influence of the unknown shower was recorded also by Explorer-1. Diurnal variations of particle concentration reaching 1 order of magnitude were observed too.

By means of Soviet and American space rockets several soundings of interplanetary space were performed along the flight trajectory of rockets from the earth's orbit towards the sun and in the opposite direction.

TABLE I

Satellite or Rocket	Date	S(m^2)	t(sec)	$S \times t$(m^2 sec)	h(km)	r	Flow (m^{-2} sec^{-1})
Geophysical rocket	24.5.57	4	134	536	100–200	10^{-8}	0.06
Geophysical rocket	25.8.57	4	148	592	100–210	10^{-8}	0.05
Geophysical rocket	22.2.58	4	85	340	126–297	10^{-8}	0.75
Sputnik-3	15.2.58	0.34	1.8×10^4	6×10^3	400–1880	6×10^{-8}–2×10^{-7}	7
	16–17.5.58				400–700	6×10^{-8}–2×10^{-7}	5×10^{-4}
	18–25.5.58				400–700	6×10^{-8}–2×10^{-7}	$< 10^{-4}$
Luna-1	2.1.59	0.2	3.6×10^4	7.2×10^3	2000–360000	2×10^{-8}–10^{-7}	$< 2 \times 10^{-3}$
						10^{-7}–10^{-6}	$< 5 \times 10^{-4}$
						$> 10^{-6}$	$< 10^{-4}$
Luna-2	12.9.59	0.2	1.1×10^6	2.2×10^5	2000–360000	10^{-8}–4×10^{-8}	$< 5 \times 10^{-5}$
						4×10^{-8}–4×10^{-7}	$< 5 \times 10^{-5}$
						$> 10^{-7}$	9×10^{-5}
Luna-3 interplanetary station	4–18.10.59	0.1	2.3×10^5	2.3×10^4	102000–470000	7×10^{-9}–2×10^{-8}	4×10^{-4}
						2×10^{-8}–6×10^{-8}	2×10^{-3}
						$> 6 \times 10^{-8}$	4×10^{-4}
	4–18.10.59	0.1	2.3×10^5	2.3×10^4	102000–470000	7×10^{-9}–2×10^{-8}	4×10^{-4}
						2×10^{-8}–6×10^{-8}	2×10^{-3}
						$> 6 \times 10^{-8}$	4×10^{-4}

(Table I continued)

Satellite or Rocket	Date	S(m^2)	t(sec)	$S \times t$ (m^2 sec)	h (km)	r	Flow (m^{-2} sec^{-1})
Mars probe	1.9.62	1.5	6×10^3	9×10^3	6.6×10^3– -42×10^3	$> 10^{-7}$	7×10^{-3}
	2.11– 30.12.60	1.5	2.7×10^3	4×10^4	42×10^3– -23×10^6	$> 10^{-7}$	2×10^{-5}
	31.12.62– –30.1.63	1.5	1.5×10^4	2.5×10^4	23×10^6– -45×10^6	$> 10^{-7}$	5×10^{-3}
Electron-2	30–31.1.64	0.03	5.4×10^4	1.6×10^3	7130–400	1.3×10^{-9}	1.1×10^{-1}
						4.4×10^{-9}–1.3×10^{-9}	10^{-1}
						10^{-8}–4.4×10^{-9}	6×10^{-3}
						3.3×10^{-8}–10^{-8}	4×10^{-3}
						$> 3.3 \times 10^{-8}$	10^{-3}
	2–13.2.64	0.03	1.5×10^5	4.5×10^3	7130–400	6.5×10^{-8}–2×10^{-8}	2.4×10^{-3}
	23–25.2.64	0.03	1.6×10^5	4.8×10^3	7130–400	6.5×10^{-8}–2×10^{-8}	5.8×10^{-3}
	29.2	0.02	8×10^4	2.4×10^3	7130–400	6.5×10^{-8}–2×10^{-8}	10^{-3}
	5.3	0.03	5×10^4	1.5×10^3	7130–400	6.5×10^{-8}–2×10^{-8}	1.5×10^{-3}
	3.2–5.3	0.03	1.7×10^6	5×10^4	7130–400	1.3×10^{-9}	7.5×10^{-4}
Electron-4	2.7–1.9.64	0.03	3.6×10^6	10^5	7046–405	6.5×10^{-8}–2×10^{-8}	8×10^{-5}
Zond 3	18.7.65– –21.1.66	1.5	1.6×10^7	2.4×10^7	260×10^{-6}	$> 10^{-7}$	7×10^{-5}
Venus 2	12.12.65– –26.1.66	1.5	6.4×10^6	9.6×10^6	28×10^6	$> 10^{-7}$	3×10^{-5}

On the launch day (September 1, 1962) the Interplanetary station 'Mars-1' crossed the Taurids. At a distance from 6600 to 42000 km from the earth, for 100 min of the flight, 60 impacts of meteoritic particles with masses 10^{-7} g and larger were recorded. The average impact rate was $7 \times 10^{-3}\,\mathrm{m}^{-2}\,\mathrm{sec}^{-1}$. Since for sporadic meteoritic bodies the number of impacts of the particles of the indicated mass is approximately $10^{-5}\,\mathrm{m}^{-2}\,\mathrm{sec}^{-1}$, it can be considered that all the recorded particles belonged to the flux.

The spatial density of the meteoritic bodies in the flux was extremely uneven. The particles moved in space by individual condensations observed at distances of 4000–45000 km from each other. The measured spatial density of meteoritic bodies averaged over the time of the accumulation of impacts (2 min) varied within the limits of $5.4 \sim 0.35 \times 10^{-6}\,\mathrm{m}^{-3}$, i.e., 1 meteoritic body per cube with a side of 60–140 m.

In the second half of November and in December at a distance of up to 23000000 km from the earth during observations comprising totally about 7.5 hours no impacts were recorded, i.e., it can be supposed that the data on the number of sporadic meteoritic bodies with masses 10^{-7} g and larger obtained for the vicinity of the earth's orbit (from observations at the distance of thousands of kilometres from the earth) apparently remain valid for distances from the sun, i.e., for $m\ 10^{-7}$ g, $N_{\mathrm{aver.}} = 10^{-5}\,\mathrm{m}^{-2}\,\mathrm{sec}^{-1}$ or less.

From December 31, 1962, to January 30, 1963, at a distance from the earth of 23000000 to 45000000 km, the Mars 1 probe again recorded the increased density of meteoritic matter in interplanetary space. This aggregation was not identified with any meteoritic flux known on the earth. During the total registration time of about 4 hours, 104 impacts were recorded, the average impact rate being $4.5 \times 10^{-3}\,\mathrm{m}^{-2}\,\mathrm{sec}^{-1}$.

The spatial density of meteoritic bodies in this formation was uneven as it was in the Taurids. Some condensations had densities varying within $1.7 \times 10^{-6} \sim 6.7 \times 10^{-4}\,\mathrm{m}^{-3}$ and the distance between them varied from 8000 to 190000 km.

After January 30, 1963, instrumentation recording meteoric particles did not function. Therefore the time of continuous motion of the Mars-1 probe in the medium with enhanced spatial density of meteoritic bodies is unknown.

Investigations by means of Zonds and Venus-2 probes launched in 1965 have made it possible to measure spatial density of meteoritic particles along flight trajectories from the earth's orbit away from the sun up to 47000000 km and towards the sun to a distance of 25000000 km. Impacts of meteoritic particles were recorded by means of piezoelectric detectors located on the back of solar batteries. The pick-offs were sensitive to impacts of particles with a mass of 10^{-7} g and larger (a particle's velocity being 15 km/sec). The area sensitive to impacts was 1.5 square metres. Signals from the sensors were transferred to the electronic block which memorized the impact rate and fed it to the telemetry device. In most cases the impact accumulation time was four hours, in some cases it was 2 min, and sometimes a few days and even more than 1 month. Since overload of the counting circuits of the electronic block is possible and therefore loss of information is also possible, the impact rate recorded in experiments should be considered to be minimal.

Zond-3 and Venus-2 have recorded, in interplanetary space, the presence of mete-

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oritic particle aggregations whose extent varied in wide limits, reaching millions of kilometres [17]. The long aggregations recorded by the space probes contained individual condensations of meteoric particles for which the impact rate per square metre per second varied from 10^{-1} to 10^{-5}. It should be mentioned that the interval between individual aggregations, when not a single impact was registered, was from a few days to about 1 month. From this it follows that the spatial density of particles with masses 10^{-7} g at a definite, sufficiently long time and in definite regions of space, was lower than 10^{-6} to 2.10^{-7} particles m^{-2} sec^{-1}.

Kramer's theoretical calculations (U.S.S.R.) have shown that the great part of aggregations observed in these distances coincided with the intersection points of the ecliptic plane by meteoric showers and comets.

Measurements from Zond-3 and Venus-2 probes have evidenced the lack of a considerable difference in average spatial density of the material to the sun and material away from the sun. The average quantity of meteoric matter recorded in these experiments (including showers) in the direction away from the sun exceeded that in the direction toward the sun by a factor of approximately 1.5 to 2.

The density of meteoric matter in space is very non-uniform and that is why the data (Zond-3, Venus-2) cannot serve as the basis for some conclusion about the distribution of meteoritic matter in the solar system.

Measurements by means of rockets and satellites have demonstrated that the density of meteoric particles is subjected to spatial and time fluctuations. Apart from fluxes, individual aggregations of meteoric particles with an unequal spatial density of particles in them have been observed. The linear dimensions of this aggregations varied within wide limits. It seems that there are also very rarefied formations whose defection presents difficulties due to their small spatial density.

Thus, on the basis of experiments performed in the U.S.S.R. and the U.S.A. it becomes ever clearer that non-uniformity in the distribution of meteoric matter in space is a rule rather than an exception.

New measurements of the flux of interplanetary dust particles in interplanetary space have been obtained from experiments on the Mariner-IV spacecraft [18]. For the first time Mariner-IV measurements provide a second data sample over the same heliocentric distance in the zodiacal dust cloud (1.1 AU–1.25 AU) by the same instrumentation. This considerably increases their reliability. In the first case, the flux of dust was 7.3×10^{-5} particles 1 m^2 sec^{-1} $ster^{-1}$, and in the second case it was 1.1×10^{-4} particles/m^2sec.ster (with the instrumentation sensitivity). The results of the Mariner-IV experiments are in agreement with Zond-3 data. Space density of meteoric particles from Zond-3 experiments without particles belonging to known meteor showers were 2×10^{-5} particles $m^{-2}sec^{-1}$ (form 10^{-7} g).

Lately, investigations of interplanetary matter have been carried out in the vicinity of the moon. By means of the satellite Luna-10 from April 3 to May 29, 1966, for a time period of 13 hours 32 min, 247 impacts were recorded which amounts to 4×10^{-3} imp m^{-2}sec and exceeds the average for interplanetary space by about 2 orders of magnitude [20].

Future experiments, however, must show whether it is a characteristic of the moon halo or is a result of the moon's passage through some aggregation of dust particles.

Unfortunately, investigations on the satellite Luna-12 from October 12 to December 7, 1966 were carried out mostly during meteor showers. During the time of our observations the satellite was in the parts of the orbit shielded from the showers only during

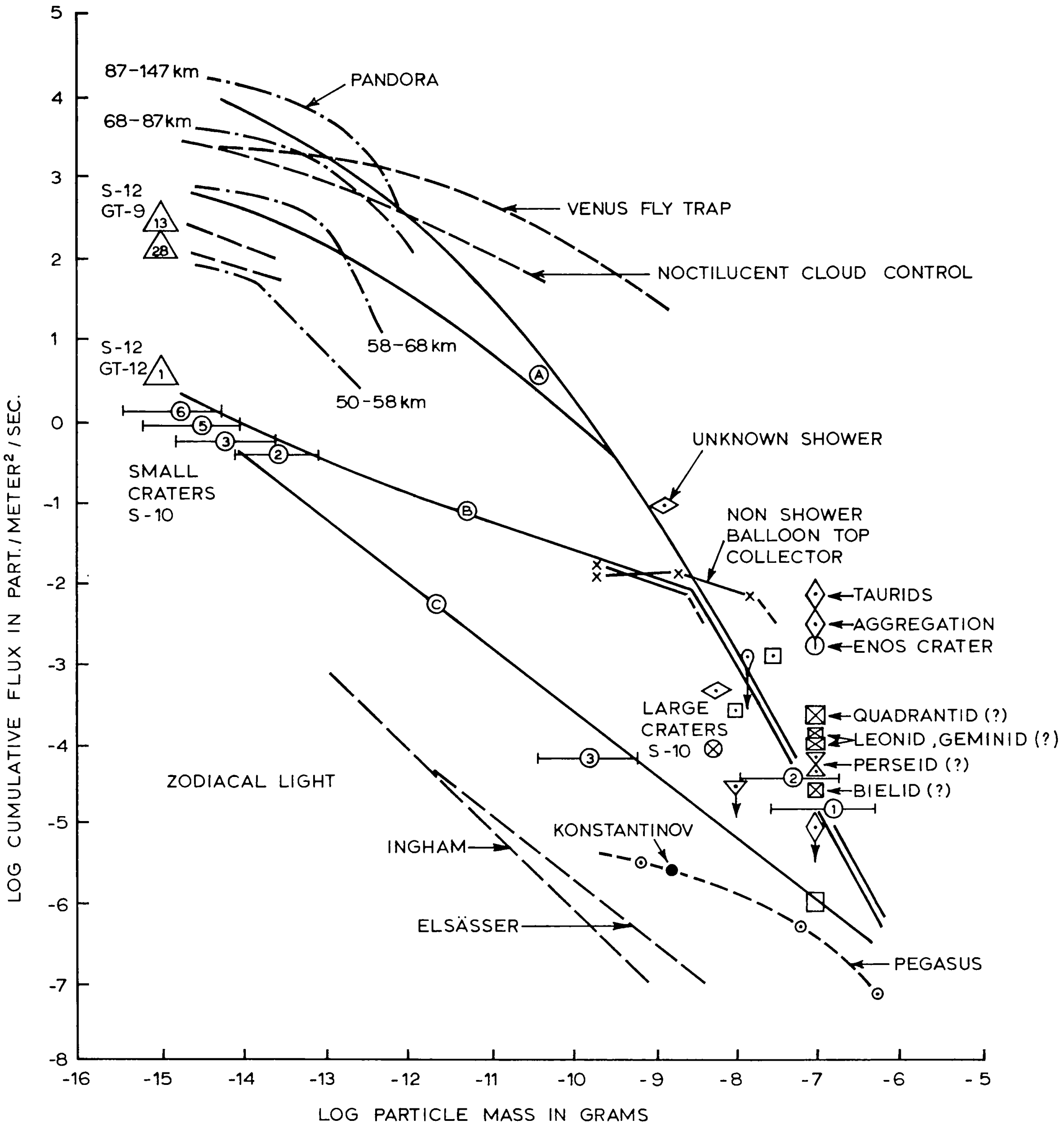

Fig. 1. Mass spectrum of meteoric particles as compiled by Dr. Hemenway with addition of U.S.S.R. data. Curve *A* – satellite and rocket microphone data as published by McCracken and Dubin; curve *B* – Hemenway's model.

◇ Sputnik-3	(U.S.S.R., Nazarova),	◇ Satellite Electron-2	(U.S.S.R., Nazarova),
○ Space rocket-1	(U.S.S.R., Nazarova),	⊗ Satellite Electron-4	(U.S.S.R., Nazarova),
▽ Space rocket-2	(U.S.S.R., Nazarova),	△ Zond-3	(U.S.S.R., Nazarova),
⊡ Space rocket-3 (interplanetary station)	(U.S.S.R., Nazarova),	☒ Venus-2	(U.S.S.R., Nazarova),
		● Satellite of Konstantinov (U.S.S.R.)	(U.S.S.R., Nazarova),
◇ Mars probe	(U.S.S.R., Nazarova),		

a very short time interval. This was not enough to consider this experiment as a proof for the validity or invalidity of the hypothesis of the existence of a lunar dust halo.

HEMENWAY *et al.* [20] has compiled a summary graph (Figure 1) representing data obtained by different methods, by means of vehicles and at different distances from the earth.

As we mentioned above, in our opinion, the data of measurements at altitudes from about 100–200 km should be considered individually. In analysing the data one should keep in mind that the results obtained by means of different vehicle methods cannot be compared simply. One should take into consideration the time of the experiments, too, because some of them were carried out during meteor showers. Taking into account all these facts the curve close to the curve '*B*' proposed by Hemenway seems to be the most acceptable average curve of particle mass distribution (outside the earth's dust envelope). This curve in interval masses 10^{-7}–10^{-9} g coincides with curve '*A*' by McCracken and Dubin. Until we have assumed a velocity value of particles in deciphering data this curve will enable us to get only a concept of the mass spectrum. We emphasize once more that this curve is average because the density of meteor particles is subject to great space and time fluctuation. From our data plotted on the graph we have selected the data related to the meteor showers and aggregations.

To find out the regularities in spatial distribution of meteoric matter, data relating to its different regions should be accumulated systematically. As to the mass spectrum of particles, its precise determination will become possible when with earth measurement the particle velocity is determined. In our opinion, obtaining meteoric particles from large heights and the determination of their physical properties and chemical composition is a very topical and at the same time a very difficult task. These experiments will be an important contribution to accumulating statistic data about space density of meteoric matter too. Many scientists the world over are working to find a solution to these problems. Their joint efforts will make it possible to understand much about the solid component of interplanetary matter which, at present, is unknown or insufficiently known to us.

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