**DELIVERY OF METEORITES TO THE EARTH FROM THE EDGEWORTH–KUIPER BELT.** S. I. Ipatov, Institute of Applied Mathematics, Miusskaya sq. 4, Moscow 125047, Russia; ipatov@spp.keldysh.ru, A. A. Mardon, Antarctic Institute of Canada, PO Box 1223, MPO, Edmonton, Alberta, T5J–2M4, Canada; mardon@freenet.edmonton.ab.ca.

Some bodies of the Edgeworth–Kuiper belt can migrate inside the orbit of Pluto. Most of such bodies are thrown into hyperbolic orbits by the giant planets, but some of them could reach the orbit of the Earth. Ipatov [1] estimated the number of 1-km Edgeworth–Kuiper belt objects (EKBOs) migrating to the orbit of the Earth. During their way to the Earth, EKBOs cross the orbit of Jupiter. The number of EKBOs, which reached the Jupiter's orbit during the considered time $T$, equals to $N_J = N \cdot P_N \cdot p_{JN}$, where $N$ is the number of objects in the belt, $P_N$ is the portion of EKBOs migrating to the Neptune's orbit during $T$ and leaving the belt, $p_{JN}$ is the portion of Neptune–crossing objects, which reach the Jupiter's orbit during their life–times. The number of EKBOs, which are now crossing the Jupiter's orbit, equals to $N_{JN} = N_J \cdot \Delta t_J/T$, where $\Delta t_J$ is the average time, during which the object crosses the Jupiter's orbit.

It is considered that there are about $10^{10}$ bodies with diameter $d > 1$ km and $30 \le a \le 50$ AU. Duncan *et al.* [2] investigated migration of EKBOs under the gravitational influence of the giant planets and obtained that $P_N \approx 0.1 - 0.2$ for $T = 4 \cdot 10^9$ yr and $p_{JN} = 0.34$. As mutual gravitational influence of EKBOs also plays a noticeable role in evolution of their orbits [3], we take $P_N = 0.2$. Basing on the above data, we have $N_J = 6.8 \cdot 10^8$ for $T = 4 \cdot 10^9$ yr and $N = 10^{10}$, and also $N_{NJ} = 3.4 \cdot 10^4$ at $\Delta t_J = 0.2$ Myr.

The number of EKBOs, which reached the orbit of the Earth during the considered time span $T$, equals to $N_E = N_J \cdot p_{JE} = N \cdot P_N \cdot p_{JN} \cdot p_{JE}$ , where $p_{JE}$ is the portion of Jupiter–crossing objects that reach the orbit of the Earth during their life–times. The ratio of the number $N_{EN}$ of Earth–crossing objects (ECOs), which came from the Edgeworth–Kuiper belt, to the total number $N_{ECO}$ of ECOs at the considered time moment equals to $P_{NE} = N_{EN}/N_{ECO} = N \cdot P_N \cdot p_{JN} \cdot p_{JE} \cdot \Delta t_E/(T \cdot N_{ECO})$, where $N_{NE} = N_E \cdot \Delta t_E/T$, $\Delta t_E$ is the mean time, during which the Jupiter–crossing object crosses the orbit of the Earth. The number of collisions of EKBOs with the Earth during time $T$ equals to $N_{col} = N_E \cdot \Delta t_E/T_E$, where $T_E$ is a characteristic time elapsed up to a collision of an ECO with the Earth. Basing on computer runs, we estimated $p_{JE} = 0.2$ and $\Delta t \approx 5000$ yr. According to [4], $T_E \approx (3/4) \cdot 10^8$ yr. So, for objects with diameter $d \ge 1$ km at $N_{ECO} = 750$ and $T = 4 \cdot 10^9$ yr, we have $P_{NE} \approx 0.2$, $N_E = 1.4 \cdot 10^8$, $N_{NE} = 170$, $N_{col} \approx 10^4$. For $d \ge 100$ km and $N = 7 \cdot 10^4$, the probability of a collision with the Earth during $T = 4 \cdot 10^9$ yr is equal to 0.06. The above estimates are very approximate, but they show that the number of EKBOs hitting the Earth is not small. Bodies with $a > 50$ AU moving in eccentric orbits also can migrate to the Earth.

It is more easy to destruct icy–volatile bodies than stone or metal bodies. The icy–volatile bodies are like dirty snowballs and structurally can break up at close encounters with planets into a set of bodies as what happened with some comets that formed meteor streams and with the comet Shoemaker–Levy 9 that hit Jupiter. Therefore, the portion of small EKBOs reaching the orbit of the Earth may be greater than that for 1 km objects and can exceed 20%, but small icy bodies disappear in the atmosphere and can not reach the surface of the Earth.

A large amount of water, comparable to the mass of water in oceans, could be delivered to Earth during the time of accumulation of Uranus and Neptune [4].

Meteorites are distinguished by different compositions. The above meteorites recovery might not indicate the compositions of meteors that enter the Earth's atmosphere. Recovery techniques and weathering might give us an incorrect picture of meteors that hit the Earth.

Icy-volatile meteors might not be indicated in the meteorites that are discovered. Antarctic meteorites are likely the most accurate picture of the distribution of meteorites falling to the Earth. The are put into the Antarctic 'deep freeze'. Icy–volatile meteors will likely not make it to the ground. It is because of the Outer Solar System substantial number of icy–volatile meteors, we will not get an accurate picture of recovered meteorites as compared to Earth–crossing Outer Solar System objects. The icy–volatile meteors are a present day example of a much smaller scale of how the oceans, other water and volatiles were delivered to the Earth.

Icy–volatile meteors that fall will likely either melt during its descent through the Earth's atmosphere or melt once it hits the ground. Another meteor type is carbon based meteors. These might also be under repressented in meteorites recovered. Therefore, the authors want to emphasize that the meteor falls might not be fully indicated by infall composition of meteors. This impacts on how we view Outer Solar System Earth–crossing objects both small and large. This has some bearing on how we decide the type of composition of Earth–crossing objects are coming from the Outer Solar System based on terrestrial meteorite recovery.

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