(2) Imagine that part of the "dark" mass in the Universe consists of solid grains, each of volume 10^{-3} cm^3 and density 1 g cm^{-3}, uniformly distributed so as to raise the mean local density in intergalactic space to 10^{-30} g cm^{-3}. Would the resulting opacity of space be detectable? How many such grains would the earth encounter daily?

The number density in space of these 1-mg grains would have to be 10^{-27} cm^{-3}—which happens to be roughly one grain per Earth-volume! The cross section of such a grain for absorbing or scattering a visible photon is about equal to its geometrical cross section, 0.01 cm^2, and is surely not much larger than that for photons of any wavelength. This limits the mean free path of a photon to something like $1/(10^{-27} \times 10^{-2})$ or 10^{29} cm. As that is somewhat greater than the present "size of the Universe," or Hubble distance, we conclude that the opacity introduced by such a population of grains would not be at present observable. The number of such grains encountered by the Earth, per second, would be given by $\pi R^2 nv$, where R is the Earth's radius, n is the spatial density, in this case 10^{-27} cm^{-3}, and v is the mean velocity of the grains relative to the Earth. That could hardly be less than the speed of the Earth itself in the solar frame, 30 km/s. A speed of 100 km/s seems more plausible, in which case the Earth would collect 1000 grains a day. That is a very small fraction of the meteoric material swept up by the Earth daily, and would probably go unnoticed.