Ernst Julius Öpik, an Undervalued Estonian Precursor of the Alvarez Impact Catastrophism

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Ernst Julius Öpik (1893–1985); from http://star.arm.ac.uk/history/opik/biog.html.

Until the 1980s, a possible role for lethal extraterrestrial impacts on the history of life on Earth, starting from the geological record of bolide strikes, was usually seen as a great puzzle, even though spectacular ideas had sporadically emerged already during the 17th and 18th centuries (e.g., Palmer 2003). Among leading scientific journals, the questions were only marginally highlighted in *Nature* (e.g., Spencer 1932; Urey 1957; see a case history in Kölbl-Ebert 2003). The gradualist uniformitarian doctrine was the overwhelming deductive dogma of science of that time, but strikingly heretical neo-catastrophic concepts still appeared from time to time (and were invariably ignored and forgotten). For example, "the occasion (...) of all the sudden geological ages" was explained by frequent large-scale impacts as early as 1925 by William Comyns Beaumont, an English eccentric science journalist, in his book *The Riddle of the Earth* (fide Peiser 1996).

Ernst Julius Öpik was a brilliant Estonian astronomer and astrophysicist, who, as a former volunteer in the White Russian army, moved in 1948 to Northern Ireland. His extensive interests encompassed, among others, stellar structure, the age and evolution of the Universe, the physical theory of meteors, statistical analysis of Earth-crossing minor bodies, mechanics of celestial collisions (since 1916!), but also the initial cause of the Ice Ages (Lindsay 1972; Öpik 1977). For him, hypervelocity collisions in space and terrestrial impact scars were undeniable facts. He published in 1936 a two-part study addressing both these matters, jointly with a physical model of a "meteor crater" (Öpik 1936).

Öpik's interest in a causal link between the evolution of the biosphere and catastrophic cosmic phenomena was probably stimulated by his younger brother, Armin Aleksander Öpik, a distinguished geologist and paleontologist who had studied Early Paleozoic stratigraphy and faunas in Estonia and Australia, mainly trilobites and brachiopods (Glaessner et al. 1985). Unfortunately, this key theme was only undertaken in two short notes published in a little-known Irish journal. Öpik (1958) explored effect estimates of celestial object crashes based on the models of impact physics, the probability of collisions between cosmic objects, the geological signature of crater "weathering survival", and the size distribution of craters on the Moon. Öpik defined formulae for calculation of volumes of vaporised, melted and crushed rocks, and stressed the harmful consequence of molten lava and hot gaseous injections. He therefore connected basaltic plateaus, that recurred with intervals of tens of millions of years, with the "impact of external bodies" at least 2 km in size. In the cataclysm model, only marine life would have survived. Öpik (1958) considered the orbital dynamics of different classes of comets and asteroids and their potential to strike the Earth. For the first time, he approximated the temporal frequency of impacts and corresponding lethal areas, determined by 12 different projectile sizes. He calculated that the mean expectation interval between collisions for all 0.1 km bodies was in the order of 10 thousand years, but 2.9, 260, and 4,400 million years for 1, 8.5, and 34 km objects, respectively. Öpik (1958: 36) regarded bolides larger than 34 km as a worldwide calamity risk, and predicted: "It appears quite possible that development of land life during the Proterozoic era (earlier than 500 milion years ago), may have been handicapped, among other causes, by catastrophic collisions". He later argued for the rapid demise of Cambrian trilobites, rather than Cretaceous dinosaurs, as the biotic record of a huge collision with a ~50 km body (Öpik 1970). The inescapable bombardment hazard was very conservatively assessed and in fact underrated by at least a factor 4 in the light of modern knowledge.

Öpik's novel probabilistic approach was quoted by Alvarez et al. (1980), and in several review papers (e.g., D'Hondt 1998; Palmer 2003), but he is one of less known planetary science pioneers, who explicitly recognized the extraterrestrial aspects of terrestrial catastrophes. Öpik (1977: 17) finally believed that "He [the author] sincerely wishes that his words may not completely remain a lonely cry in the wilderness, but may perhaps at some time help someone in the impartial search for truth". Was he right?

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