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# TSIOLKOVSKY AND EXTRATERRESTRIAL INTELLIGENCE

B. FINNEY, L. FINNEY
University of Hawaii, Honolulu, HI 96822, USA

V. LYTKIN
Tsiolkovsky State Museum of the History of cosmonautics, Kaluga, Russia

**Abstract**—Where is everybody? Fermi's famous question about the apparent absence of evidence of extraterrestrials and the answers to it offered by Ball, Kuiper and Morris during the search for extraterrestrial intelligence (SETI) debates of the 1970s were anticipated in the writings of the pioneering Russian space theorist Konstantin Tsiolkovsky. Although Tsiolkovsky is most widely known for his work on spaceflight theory and his visions of humans living in space, he was also a dedicated monist who believed life existed throughout the cosmos and that we were surrounded by extraterrestrial species far more intelligent than us. To explain why advanced extraterrestrials had not made their presence known to us, or, more importantly, had not interfered with our evolution to raise us to their own level, Tsiolkovsky proposed that they were deliberately leaving us alone in the hope that we might develop "a new and wonderful stream of life that will renew and supplement their already perfected life". © 2000 Elsevier Science Ltd. All rights reserved

In late 1959 *Science* published an editorial on Giuseppe Cocconi and Philip Morrison's paper about detecting extraterrestrial civilizations by their radio transmissions that had appeared earlier that year in *Nature*, and Frank Drake's announcement that he was preparing to aim a radiotelescope towards Tau Ceti and Epsilon Eridani to make the first such search [1,2]. Following the appearance of this editorial, Alexis N. Tsvetikov, a Russian émigré scientist working at Stanford University, published a letter in *Science* pointing out that decades earlier his fellow countryman, the pioneering spaceflight theorist Konstantin Tsiolkovsky, had also written about extraterrestrial life in several obscurely published essays [3]. However, despite Tsvetikov's letter, and an amplifying article he published in 1969 [4], Tsiolkovsky's ideas about extraterrestrial life have remained largely unknown.

In contrast, Tsiolkovsky has long been widely recognized as the theorist who first worked out the equation for reaching space by means of rockets, and then went on to make other significant contributions to spaceflight theory as well as to write prescient science fiction tales about humans in space [5–7]. Our ignorance about his ideas on extraterrestrial life stems in large part from the attitude of the Soviet regime toward his philosophical writings which contained these ideas. Whereas Tsiolkovsky's technical and science fiction contributions about spaceflight fit in with Soviet materialist ideology and were extensively disseminated and discussed during the Soviet era, his philosophical writings were ignored and consigned to restricted archives. Even Tsvetikov — who had known Tsiolkovsky in Russia and, after coming to the United States, had corresponded with him until Tsiolkovsky's death in 1935 — was apparently not acquainted with all his unpublished manuscripts on extraterrestrial life. Only recently have these manuscripts become freely available to scholars, thus making it possible to appreciate the relevance of this original thinker's ideas to issues about extraterrestrial life that were heatedly debated during the formative years of the search for extraterrestrial intelligence (SETI).

Tsiolkovsky's philosophical writings included essays and short monographs, only some of which were published during his lifetime. Among the papers which have recently become available are a series of brief essays about extraterrestrial life that were written for a general audience in the early 1930s, but were not published [8]. In order to provide a sample of Tsiolkovsky's reasoning, reproduced as an appendix to this paper is a translation of one of these popular essays, "The Planets are Occupied by Living Beings" [9]. In it Tsiolkovsky first outlines how other suns should have planets capable of sustaining life, how life should arise on some of these and evolve into higher forms, and so on, using a logic similar to that Drake was to apply in 1961 to develop his equation for estimating the number of communicative civilizations in the Galaxy. Such reasoning might be judged unexceptional except that it was written in 1933 during a period when many Western astronomers were still heavily influenced by James Jeans' thesis that planetary systems were the products of close stellar

encounters, and that since these were highly infrequent events planets and the evolution of life must therefore be extremely rare [10]. The rest of Tsiolkovsky's essay addresses the issue that Enrico Fermi was to raise 17 years later in 1950. If intelligent life is abundant and space travel a logical development for advanced civilizations, why haven't we been visited by our more precocious neighbors? However, whereas Fermi uttered his now-famous question — Where is everybody? — in the midst of lighthearted lunch time conversation and apparently never seriously tried to answer it [11], for Tsiolkovsky the apparent absence of contact with extraterrestrials was a major challenge to his thinking that he went out of his way to resolve.

Since Tsiolkovsky wrote most of his philosophical essays later in his life after developing spaceflight theory, it might be tempting to dismiss his ideas about extraterrestrial life as the amateurish musings of an elderly thinker long past his creative prime. However, this would ignore the fact that Tsiolkovsky's work on spaceflight was primarily driven by humanistic goals, and that Tsiolkovsky himself was a leading figure in a philosophical-scientific movement called "Russian Cosmism" [12–14]. This movement, which flourished in the late 19th and early 20th centuries, included a wide range of thinkers — poets, artists, theologians and philosophers as well as scientists — who sought to link humanity with the wider cosmos. In particular, Tsiolkovsky seems to have been influenced by Nikolai Fedorov, a leading ideolog of this movement who believed that humans should colonize space and seek perfection there [15,16]. Fedorov, who worked as a librarian in Moscow, aided the young Tsiolkovsky when he came to Moscow in the 1870s, giving him a place to work in the library and piling his desk high with books. Although sources differ as to how directly Fedorov pointed Tsiolkovsky toward space, it is clear that after his unique education Tsiolkovsky devoted his life to thinking about space both technologically and philosophically. For him, reaching space and learning to live there were not ends in themselves, but means by which our descendants could escape the poverty and oppression of Earth and evolve into the immortal, perfect and happy beings of his mentor's vision [17].

In his philosophical writings Tsiolkovsky declared himself a monist who held that all parts of the universe were basically the same, and that the same laws applied throughout [18]. He linked his monism with the panpsychic belief that the whole universe was alive and that everywhere was to be found the potential for intelligence if not its actual expression [19]. His imagined cosmos was therefore filled with intelligent beings in various stages of evolution. However, in invoking monism and panpsychism to deduce the prevalence of intelligent life, Tsiolkovsky had to deal with the implications of his earlier theorizing about the destiny of our species to spread into space. As indicated by his often quoted saying — "The planet is the cradle of intelligence, but it is impossible to live forever in the cradle" — Tsiolkovsky envisioned humans colonizing the Solar System and eventually expanding into the depths of the Cosmos [20,21]. As a dedicated monist, Tsiolkovsky also had to assume that this same destiny must be shared by multitudes of other intelligent civilizations that had evolved elsewhere. As it is likely that many of these were far more advanced than our species he reasoned that we should have been visited by representatives of one or more of the advanced civilizations that had already achieved spaceflight and a full mastery of nature, or have been contacted by them through other means.

That advanced extraterrestrials apparently had neither visited us nor otherwise made their existence known to us challenged the whole logical structure of Tsiolkovsky's life work. To be consistent, Tsiolkovsky either had to abandon his vision of the inevitability of humankind expanding into space, or his conception of a universe populated by countless intelligent civilizations. In "The Planets are Occupied by Living Beings" Tsiolkovskys sought to get out of his dilemma by hypothesizing that "our means are too weak to be able to perceive" any signs advanced extraterrestrials might give us to indicate their existence, and that they may be holding off visiting us because we are in too low a state of intelligence to react rationally to them, and might end up being destroyed by the encounter. Yet, he also thought that "the time must come when the average degree of development of mankind would be high enough for us to be visited by heavenly inhabitants".

Tsiolkovsky amplified this line of reasoning in "Natural Principles", an unpublished essay written in 1934 a year before his death [22]. Very few advanced civilizations, he proposed, develop naturally in isolation, passing through all stages of evolution, all the "trials and sufferings" necessary to achieve ultimate perfection and happiness. The first civilizations to evolve to this high level in a particular region of the Universe then seek to uplift their lowly neighbors from nearby star systems, bringing them to their level of development. But in so doing they necessarily extinguish the unique evolutionary streams of their less advanced neighbors. We, Tsiolkovsky suggested, must have been spared this uplifting process by our benign, advanced neighbors. He hypothesized that Earth had been deliberately set aside as a preserve of intelligent life in the early stages of development in order to allow our species to evolve independently to perfection in order that we might bring something new and unique to the community of advanced yet jaded civilizations looking for novel solutions to the problems of existence:

> Why don't the beings of happy planets deign to come

down to us? Why don't they pity us, and replace us with higher beings, destroying us so that we can then arise in their perfect image?...If they didn't expect anything of a high level from us, then they wouldn't have tormented us for so long. Apparently, there is hope that something worthwhile will develop from us. They know better. We doubt, but they know. We can bring a new and wonderful stream of life that will renew and supplement their already perfected life.

A year before he wrote the above, Tsiolkovsky had ended "The Planets are Occupied by Living Beings" with the enigmatic assertion that "there are a number of strange facts that prove the participation of alien beings in our life. This is direct proof of the existence of different, more developed organisms". Just what were these "strange facts"? Judging from his unpublished notes, Tsiolkovsky was referring to visions, which have typically been labeled mystical or religious, that had been seen in the heavens by chosen people. Tsiolkovsky, who privately recorded that he himself had seen two such visions, believed that advanced extraterrestrials who had mastered the laws of the Universe and thereby had developed godlike powers were sending them to selected individuals on Earth. Their goal, he hypothesized, was to encourage humanity by telling us that we were not alone in the Universe, and that we were on the right track in our struggle to develop our civilization. That this unusual thinker did not reveal these beliefs in this or other essays is understandable, particularly in the Soviet Union of the early 1930s. Here is where Tsiolkovsky's cosmic philosophy clashed most directly with the canons of scientific materialism.

As the search for radio signals from extraterrestrial civilizations was beginning to be developed in the 1970s, Fermi's question — Where is everybody? — was recalled and a lively exchange of opinions on how to answer it appeared in journal articles and books. Because the manuscripts from which we have been quoting were not then publicly available, Tsiolkovsky's prior thinking was not discussed in this debate. However, at this time several theorists essentially reinvented Tsiolkovsky's ultimate solution to the puzzle of the apparent absence of visitations by extraterrestrials. John Ball proposed his "zoo hypothesis" to explain why we have not been visited by higher beings, and T. B. H. Kuiper and M. Morris suggested a more refined version that strikingly mirrored Tsiolkovsky's thinking: Earth is quarantined so that our evolution might proceed to the point where our unique scientific and cultural achievements could provide valuable knowledge to advanced extraterrestrials [23,24].

In contrast, a number of other theorists rejected the possibility that both extraterrestrial intelligent life and interstellar space travel could coexist. In particular, we refer to such SETI critics Michael Hart and Frank Tipler who argued that extraterrestrials do not exist because if they did the more advanced among them would have long ago developed interstellar travel and have already visited us in person or by means of robotic space probes [25,26], and such SETI advocates as Bernard Oliver, Frank Drake and John Wolfe who, following the lead of Edwin Purcell, proposed that advanced extraterrestrials have not visited Earth because interstellar spaceflight would be so prohibitively expensive that they would prefer the vastly cheaper, more expeditious and therefore more intelligent alternative of establishing radio communication [27–32]. Since the evolution of intelligent life throughout the Cosmos and the development of spaceflight and consequent expansion of intelligent species beyond their natal star systems were the twin pillars of Tsiolkovsky's thinking, he could not have accepted any such solution that denied one or the other.

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## APPENDIX A

### *The planets are occupied by living beings — manuscript of Konstantin E. Tsiolkovsky dated 5 September 1933*

Many educated and world renowned scholars do not believe in the existence of animals on other planets on the grounds that nobody has seen them, and that they do not reveal themselves in any way. Similarly, for a long time Europeans were ignorant of the existence of America and its people.

We would like to prove the opposite: there is no way to doubt that the numberless planets are populated.

There are unquestionable facts, although it is not now possible to check them. For example, in theory we know the composition of the surface of suns, even though we haven't touched a single tiny fragment of their substance. We know a lot about heavenly bodies, for example, their sizes, distances and densities. But nobody has measured them directly, and now it is only possible to verify this information theoretically. Nobody has seen atoms, but they undoubtedly exist. There are also solid grounds for being absolutely sure of the numberless population of heavenly inhabitants.

What are these grounds? We will name them.

1. All the trillions of suns and all the rarefied gaseous heavenly masses are composed from the same substance as is our Earth.
2. All planets have separated from suns. Therefore they are also composed from the same matter that formed our planet.
3. All heavenly bodies are subjected to gravity. Therefore all planets have gravity.
4. There are liquids and gases on all big planets.
5. All planets are sunlit with similar rays from their suns.
6. Almost all planets have diurnal periods and seasons.

We can see from all this that planets of different solar systems differ from each other not in quality but in quantity: they have different sizes, different weights, oceans of different depths, different average temperatures, diurnal periods and seasons of different length, different distinctions between seasons and so on. But of course there are planets which are very much like Earth.

Every sun has about ten big planets and thousands of small ones. At least one of them is similar to Earth: in temperature, size, weight, water, air and so on. So how can one deny organic life on them?

We can count billion of suns in the known universe. It means there are many planets like Earth. It's incredible to deny life on them. If it appeared on Earth, then why could it not appear on planets similar to Earth under the same conditions? There may be less planets than suns, but nevertheless they must exist. You can deny life on 50, 70 or 90% of all these planets, but its absolutely impossible do so for all of them.

And besides, do different conditions necessarily exclude life? Even on our planet there are many local differences in temperature, environment (water, air, soils) and so on. Nevertheless, where on earth are there no plants and animals? It is possible to find them even in polar snow, on the heights and in the depths. Neither the absence of light, or cold, or heat or anything else can stop the development of organisms on Earth. Therefore every sun has not one but probably several populated planets.

The technological power of anthropoid beings is also critical. Thanks to it people on Earth are capable of building a very comfortable life at the poles, in the deserts, in the mountains, under the water, above earth, in the ether and wherever they might like. This will be especially true for our powerful descendants.

What are the grounds on which people deny the presence of intelligent beings on the planets of universe? We will name them.

We are told: if these beings exist they would have visited Earth. My answer is: probably, they will visit us, but it is not yet time for that. Aboriginal Australians and Native Americans of past centuries were finally visited by Europeans, but many thousands years passed before they appeared. Similarly, we also will be visited some time in

the future. Probably the powerful inhabitants of other planets have been visiting one another for a long time.

A further argument against my thesis: if they exist they would have given us some sign of their existence. My answer is: our means are too weak to be able to perceive these signs. Our heavenly neighbors understand that with a certain degree of development of knowledge the people themselves will prove without a doubt that the other planets are populated. Besides, because of the low level of development of animals, and the majority of humankind, there is no reason to inform them that the planets are populated. Would this knowledge even bring harm? Would pogroms and the Massacres of St. Bartholomew result from it?

The time must come when the average degree of development of mankind would be high enough for us to be visited by heavenly inhabitants. We are brothers, but we kill each other, start wars and treat animals brutally. How would we treat absolute strangers? Wouldn't we consider them our rivals for the possession of the Earth, and wouldn't we ruin ourselves in this unequal struggle? They cannot wish this struggle and destruction. Mankind, in its development, is as far from the more perfect heavenly beings as lower animals are from people. We would not visit wolves, snakes or gorillas. We only kill them. Perfect heavenly beings do not want to do this to us.

Can we really have rational relationships with dogs and monkeys? In the same manner, higher beings are not able to communicate with us for the present. On the other hand, there are a number of strange facts that prove the participation of alien beings in our life. This is direct proof of the existence of different, more developed organisms.