

One hundred and fifty years of a dreamer and fifty years of realization of his dream: Konstantin Eduardovitch Tsiolkovsky and the *Sputnik 1*

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Russia as a country underwent a huge transformation in the last 100 years or so, from political, scientific, technological and literary points of view. It produced stalwarts in different fields, particularly during the Soviet era, though all of these achievements did not appear to be well documented in the West (Europe and the USA). During the Cold War years, the mutual mistrust between the Soviet Russia (USSR) and the USA reached a different height. With Soviet Russia putting up 'firsts' from that country in virtually all fields of science and technology, and the West taking them with a pinch of salt or simply refusing to accept them, proved to be a common phenomenon. That, in a way, has still kept an important part of the history of development of science and technology of the last century out of our reach.

However, even with this hue and cry and in the midst of efforts to go for on-upmanship by both the sides, some things emerged undisputed. And one such issue was the acceptance of Konstantin Eduardovitch Tsiolkovsky, born 150 years ago on 17 September 1857, as the father of space travel and development of liquid gas-fuelled rockets. In spite of the work in the field of astronautics by Robert Goddard, Herman Obethe and Wehrner von Braun in the USA and Germany, which is widely known and acknowledged by one and all, this school teacher from Russia stands tall. Tsiolkovsky spent a significant part of his active life at Kaluga, a small town 220 km northwest of Moscow. He is acknowledged as the first man to develop the right mathematics and propagate the correct concepts and ideas that led to the development of rockets suitable for putting the bodies in orbits close to the earth at the upper ends of the atmosphere or just beyond. And it was indeed not an easy task, considering the fact that he would have been 150 years old today.

It was during 1903 that the Wright brothers demonstrated their flying machines and an era of flying and moving through the atmosphere with great speeds could be dreamt of. However, most of us have

forgotten that in the same year, Tsiolkovsky published a paper in Russian entitled (loosely translated in English) 'Exploration of the universe with reaction machines' in *The Science Review* that essentially dealt with the possible motion of a rocket whose mass is variable, i.e. reduces with time because of the discharge of burning fuel that provides thrust as a reaction force; and the so called 'payload' moving towards the upper ends of the atmosphere. He developed the concept of rocket movement with the help of his now famous rocket equation and showed that the height of space attained and the time to remain in space was limited through the exhaust velocity of the gases. The heart of the paper had a concept or so to speak a dream, involving journey to space by human being. This paper and a few of his other papers on associated ideas published in 1911, 1912 and 1914, are now accepted as scientifically sound papers on the subject of space travel. He also proposed the concept of multistage rocket. So, before man could actually begin to fly in an aeroplane, the proposal for space travel had existed.

Interestingly, the first man-made object to reach the outer edges of the atmosphere or space was an artificial satellite. The event took place in the centenary year of Tsiolkovsky and quite fittingly, it was an effort by the Soviet Russia. This satellite *Sputnik 1*, is far better known than Tsiolkovsky. An artificial satellite revolving around the earth in a low orbit today sounds like a routine affair. But fifty years ago it was indeed a big event. And at the centre of the event was an 85 kg, 58 cm diameter sphere with four long, whisker-like antennas, all lying in a single direction. It was orbiting around the earth in an orbit about 250 km from the surface of the earth, at the upper edge of the atmosphere, taking about 96 min to complete one revolution. Its apogee was 984 km and perigee was 241 km. Today, satellites of this size are put in orbits of this height virtually every week by different countries, to conduct scientific studies. However, *Sputnik 1* was dif-

ferent, if one considers that it was the first artificial satellite launched fifty years ago, when solar cells had not been developed and the satellite had its power sources in chemical batteries that eventually failed before its full run. Collection of signals from the satellite and their subsequent analysis by computers were entirely different, yet it was possible to receive signals from the satellite as long as it was in space. And the space age that we talk about had flagged-off with this incident.

It was the centenary year of Tsiolkovsky and the then USSR launched this satellite on 4 October 1957. It spent nearly three months in orbit. The effort to bring it back to earth was not successful, as it got burnt while entering the lower atmosphere in January 1958. But history had been made. As it happens with all such breakthroughs, ordinary people were not sure about the significance of this achievement. It is now well known that the two superpowers of those times, i.e. the USSR and the USA, gave topmost priority to their respective space programmes. The progress of the space programme and funding thereof turned into a major political decision, rather than a technological achievement. Nowadays, a technological breakthrough is much more linked to its commercial exploitation. The concept of colonizing space could be found in the writings of Tsiolkovsky, who mentioned in 1911 that the 'earth is the cradle of the mind, but we cannot remain on a cradle forever'. But there were more challenging targets when space travel actually became a reality.

Tsiolkovsky was the child of a Polish father and a Russian mother. Due to scarlet fever at the age of twelve he became hard of hearing and his school studies were seriously hampered. He did not have much formal education, though he spent about three years in Moscow in the pursuit of knowledge. He met the famous Russian philosopher Federov while at Moscow and was influenced by him. Tsiolkovsky's physiological problem along with the lack of formal university degree compelled him to work as a school

teacher. But that did not deter him from doing research and publishing profusely. With his extraordinary mathematical ability, he could develop equations for the motion of a body with a variable mass, the way a rocket moves. Interestingly, Tsiolkovsky never built a rocket but did experiments in a wind tunnel that he had developed. He however tried to conceive practically every detail of a rocket through his calculations and drawings. He was proficient in drawing, through which he could make his ideas visible and understandable. In fact, the difference between Tsiolkovsky and scientists like von Braun and Robert Goddard who actually developed practical rockets lies herein. And in spite of the fact that Tsiolkovsky did not develop any working rocket, his contribution as the pioneer in the field is now accepted by all. Interestingly, there is a striking similarity among all these rocket-personalities; all of them read and were inspired by the book *'From the Earth to the Moon'* by the French author, Jules Verne, published in 1865. This is a significant lesson for those of us who believe in the role of imagination while doing science.

Tsiolkovsky was born in what is known as Imperial Russia, i.e. when the Czars ruled the country. His scientific work did not get any significant recognition in Czarist Russia, though he did a major part of his work during that regime. He belonged to a society where the people did not mind having faith on the supremacy of certain races over the others that later on turned into an extremely controversial subject called eugenics. It is true that the motivation behind Tsiolkovsky's idea of space travel was a belief that superior races will opt for it. In fact, his stature as a scientist was not clear to the Bolsheviks, who had come to power after the Revolution, when Tsiolkovsky was sixty years old. It is now known that his activities were monitored by the secret police of the USSR and he was in fact jailed for sometime possibly due to his faith. Later on, he was given some pres-

tigious positions by the people in power. Interestingly, the leader of Soviet space programme, Sergei Pavolovich Korolev, as a bright and enthusiastic school student, used to write to Tsiolkovsky asking questions about space travel. This contact through letters between the two remained, though they possibly never met each other. Tsiolkovsky passed away in 1935, when Korolev had completed his studies and had become an aeronautical engineer with a deep conviction of the possibility of space travel. So the legacy continued. It is indeed interesting to note that Korolev was in charge of the Soviet space programme when *Sputnik 1* was put to orbit.

During the Cold War years, both the USSR and the USA tried to develop high-power liquefied gas-propelled rockets to 'protect' their respective countries from 'external invasion'. These rockets, it was believed, would be able to carry nuclear warheads, another field where extensive research and development took place. However, both countries associated a lot of national pride with these programmes, trying to convince their respective countrymen about their necessity for protecting the country. So with the USSR sending the first artificial satellite to space, the USA now planned to put more thrust on its space programme, so that the next levels of achievement could be mustered by it.

However, the USA missed the next exciting 'first' as well. The USSR sent the first man in space in 1961. He is now a household name, i.e. Yuri Gagarin. He revolved around the earth once in his spacecraft *Vostok 1* in 108 minutes and could come back to the earth safely. He started in the morning (6.07 am, UTC) of 12 April 1961 and came back at 7.55 am (UTC) on the same day. Gagarin reached back to the ground after getting himself ejected from the spacecraft 7 km above the ground. The spacecraft itself landed on the ground separately with another parachute. The USA ultimately could score a point by making the first man land on the moon in 1969.

The space race that was triggered by the launch of *Sputnik 1*, barely twelve years after the World War II had come to an end, has proved to be significant in the last fifty years. During this period the world has seen the breaking up of the USSR, space-related programmes launched by the USA (Star Wars) in the 1980s and the development of nuclear weapons that may precisely strike targets thousands of kilometres away with the help of a suitable carrier rocket. At the same time there is more stress on surveillance, with the launch of the so-called low orbit 'spy satellites', development of an 'International Space Station', where a few astronauts stay for a certain periods and in the development and proliferation of communication satellites. In fact, it now appears that the offshoots of the space programme are more significant than the programme itself. The Indian Space Research Organization has come up with a significant number of indigenous equipment to keep our space programme going. And all these inspirations can be traced back to the first dreamer, Konstantin Eduardovitch Tsiolkovsky and his dream which came true in the form of *Sputnik 1*.

Materials from the following websites and publication have been used in the note.

1. www.informatics.org/museum/tsiol.html
2. en.wikipedia.org/wiki/Konstantin_Tsiolkovsky
3. www.russianspaceweb.com/tsiolkovsky.html (Biography of Tsiolkovsky by Anatoly Zak; the site contains a number of good photographs.)
4. en.wikipedia.org/wiki/Tsiolkovsky_rocket_equation
5. www.spaceline.org/history/21.html
6. *Encyclopaedia Britannica* (1980 edition).

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