Sir Arthur C Clarke: Satellite Pioneer and Space Visionary

Nalaka Gunawardene

Sir Arthur C Clarke was the world's best known writer of science fiction at the time of his death in March 2008, aged 90.

In a remarkable career spanning over six decades, he wrote around 100 books and more than 1,000 short stories and essays. Among his best-selling novels were *Childhood's End, 2001: A Space Odyssey and Rendezvous with Rama.*

But Clarke was much more than an imaginative writer of science fiction. Trained in physics and mathematics, he also wrote many books and essays of non-fiction related to space travel, communication technologies, underwater exploration and future studies.

For decades, he was one of the world's leading promoters of space exploration. He advocated the peaceful use of space technologies and the wise use of information technologies for the benefit of all humans.

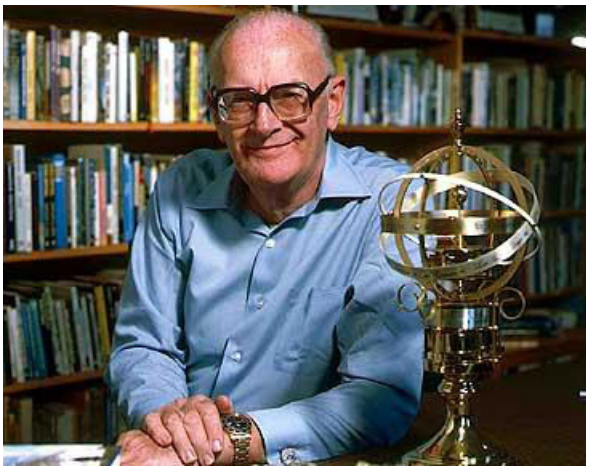
Born in Minehead, Somerset, England, in 1917, Arthur Charles Clarke was educated at Huish's Grammar School, Taunton, and later at King's College, London. In the late 1930s, Clarke worked in the British Exchequer and Audit Department, and then served as a radio instructor in the Royal Air Force during World War II. He became a full time author in 1950.

His interest in astronomy and space started early in life. As a schoolboy growing up in rural England, he was an avid observer of the night sky using his own home-made telescopes. In 1934, while still 16, he became a member of the British Interplanetary Society (BIS) – an advocacy group of starry-eyed youth who believed that one day, humans would send spacecraft to outer space.

Years later, he became one of the most active members of BIS, and served as its chairman from 1947 to 1950, and again in 1953. The BIS is credited as a pioneering citizen group that encouraged governments to support space related research and applications.

Communication Satellites

One of Clarke's most important ideas was expressed in a scientific paper in the October 1945 issue of *Wireless World,* a technical journal. In that paper -- titled *Extra-terrestrial Relays: Can Rocket Stations Give World-wide Radio Coverage?* -- he was



Sir Arthur C Clarke

the first to outline the principles of global broadcasting via communication satellites (comsats) placed in geosynchronous orbit.

He later described how war experiences had influenced his thinking.
During World War II, which lasted from 1939 to 1945, Germany used rocket technology to bomb Britain from afar. Those attacks created a bad image for rockets, but Clarke showed how the same technology can be used for peaceful purposes -- such as launching artificial satellites into orbit.

Focusing on their use for telecommunications and broadcasting, he looked for the most efficient way to provide planetary coverage with the fewest number of satellites.
Satellites in lower orbits circle the earth several times a day, but the higher a satellite is placed, the longer it takes to complete a full circle or orbit. Clarke calculated that at a certain point -- about 42,000 km or about 26,100 miles from the center of the Earth – a satellite's orbit would take exactly 24 hours.

This is the same as the Earth's rotation (which we call a 'day'). A satellite placed in such an orbit would appear to be fixed or stationary above the same point on the planet. Such a vantage position is ideal for broadcasting purposes: Clarke found that three satellites placed there over the equator could cover the entire world.

At that time, space travel was still a speculation among enthusiasts. Even Clarke did not expect Comsats to become a reality during his life time. But the dawn of the Space Age was only a dozen years ahead in the future (Soviet Union sent up Sputnik 1 in 1957). The first commercial comsat, named Early Bird, was launched in 1965 and many more followed.

Clarke never patented his idea, and earned no money from the concept that soon led to a multi-billion dollar satellite industry. He preferred to be called the 'Godfather of Comsats', giving credit to the many engineers and technicians who actually built and launched them. In his honour, the geostationary orbit is now known as the 'Clarke Orbit'.

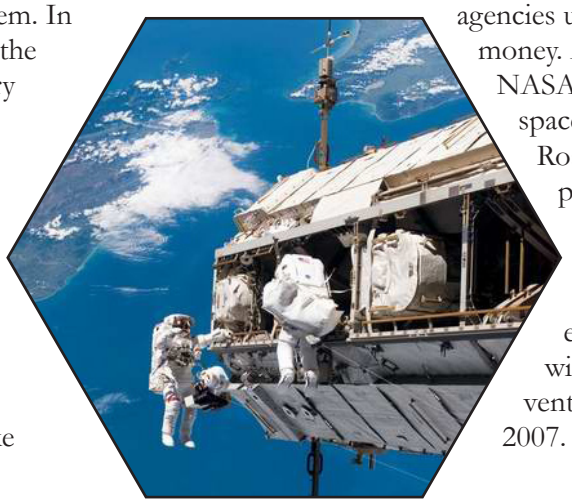
Space Travel

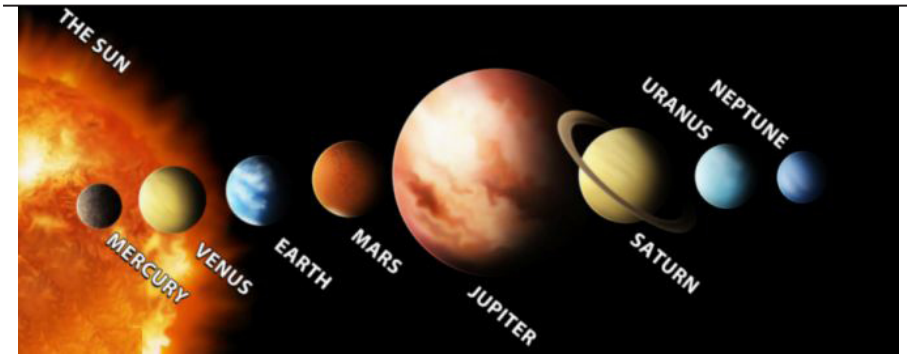
In the late 1960s, Clarke was closely associated with the Apollo programme that landed a dozen American astronauts on the Moon. He joined CBS network in providing live TV coverage of Apollo missions in 1969-70. He also wrote a substantial epilogue for *First on the Moon* (1970), the official memoir of the first humans to land on the Moon (Neil Armstrong, Edwin Aldrin and Michael Collins).

Early on however, Clarke realised that the true future of space travel lay in developing affordable alternatives to the extremely high cost rockets used for early launches of manned and unmanned spacecraft. For example, the Apollo programme cost a total of US Dollars 25.4 billion (at the time).

Writing in 1969, he predicted: "The closing years of this century should see the beginnings of commercial space flight, which will be directed first towards giant manned satellites or space platforms orbiting within a thousand miles above the earth's surface."

It took a little longer, but Clarke lived to see the early successes of privately funded space travel efforts, which ended decades of monopoly by governmental space agencies using taxpayer money. Agencies like NASA and (Russian space agency) Roscosmos were pathfinders, but will soon have to share space exploration with private ventures, he said in 2007.





Solar System

In October 2007, he wrote: "As the Space Age completes half a century, commercial space flight is beginning to be technologically feasible -- and will soon become economically viable. Before the current decade is out, fee-paying passengers will be experiencing sub-orbital flights aboard privately funded space-planes, built by a new generation of 'astropreneurs' with an unstoppable passion for space. And over the next 50 years, thousands will gain access to the orbital realm – and then, to the Moon and beyond."

In Clarke's view, one grand idea that could make space transport cheap and affordable was the Space Elevator. First developed by the Russian engineer Yuri Artsutanov in the early 1960s, it is a daring yet simple concept.

Comsats demonstrate how an object can remain poised over a fixed spot on the equator by matching its speed to the turning earth. If a cable can link such a satellite to the ground, payloads could be hoisted up it by purely mechanical means, reaching orbit without any use of rocket power. Like all elevators, it would run on electricity.

Clarke noted: "What makes the Space Elevator such an attractive option is its cost-effectiveness. The actual electrical energy required to go to space, if you purchase it from your friendly local utility, would cost around a hundred dollars. And a round-trip would cost only about one tenth of that, as most of the energy could be recovered on the way back!"

Clarke popularised the Space Elevator in his 1978 novel *The Fountains of Paradise*, which takes place in the 22nd century in the equatorial island of Taprobane -- a thinly disguised version of Sri Lanka.

Clarke's strength was that he wrote both plausible science fiction stories as well as accessible science fact. Through these, he appealed to different types of readers. Many astronauts, space scientists and engineers from around the world have acknowledged that they were inspired to pursue their careers by reading Arthur C Clarke books early in life.

The policy impact of Clarke's technical and fictional writing has yet to be properly assessed. For example, it was only decades later that he found out how the US space pioneer Dr Wernher von Braun had used his 1952 book, *The Exploration of Space*, to convince President Kennedy to go to the Moon. In a famous speech on 25 May 1961, Kennedy set the national goal of "landing a man on the Moon and returning him safely to the Earth" before the end of the 1960s.

Perhaps Clarke's greatest single contribution to popularisation of space was the movie 2001: A Space Odyssey, which he co-wrote with acclaimed film director Stanley Kubrick. From 1964 to 1968, the duo collaborated on this extraordinary cinematic venture which was expanded from Clarke's 1950 short story called *The Sentinel*.

The futuristic film, whose story takes place in the opening year of the new millennium (2001), was released in April 1968 — and went on to become one of the finest science fiction movies ever made. The movie played a key role in placing space exploration in the wider context of human evolution.

The movie was based on painstaking research and consultations with experts and research institutes on what the world of 2001 might look like. The special effects, all done manually (computer generated imagery was not available at the time), sought to create the feeling of being in space.

When cosmonaut Alexei Leonov, who in March 1965 became the first man to 'walk' in space, saw the movie, he exclaimed: "Now I feel like I've been in space twice."

Terrestrial Uses

Clarke did not just sit in his Colombo home dreaming up technologically-enabled futures for humanity. He also played an

active role in creating that future – by mentoring various technical professionals, advising the United Nations and governments, and critiquing the progress of information and communication technologies, or ICTs.

His advice was sought and valued by space agencies in the US, Russia and India. During 1975-76, he advised the Indian Space Research Organisation (ISRO) on the world's first use of comsats for direct television broadcasting aimed at rural audiences. Known as the Satellite Instructional Television Experiment (SITE) Project, the pioneering exercise beamed TV programmes on health, agriculture and other development topics to millions of people in 2,400 villages across India.

During this time, he also spent sometime at the Physical Research Laboratory in Ahmedabad, India, as a visiting professor. Grateful for advice, the Indian government gifted Clarke with a large satellite dish antenna in 1975. Using it, he was able to capture satellite TV transmissions over the Indian Ocean. His home thus became the first household in Sri Lanka to have a working television set (before TV broadcasting started in 1979).

It seems he also inspired the World Wide Web. In his 1964 short story, *Dial F for Frankenstein*, Clarke speculated the world's inter-connected telephone system becoming a conscious entity that then takes over the world. British computer scientist Tim Berners-Lee has acknowledged how this story inspired him to invent the web in 1989.

Clarke cheered when ICT tools empowered ordinary people and activists to benefit from the free flow of information, artistic creativity and the defence of human rights. He watched how government censors were undermined first by comsats and then by the web.

Clarke was intrigued by the 'CNN Effect' – the impact that CNN and other global news channels have on how states conduct their foreign policy relations in today's globalised world. In his 1992 book *How the World Was One*, he described a dream: one day in the near future, CNN founder (and then owner) Ted Turner is offered the post of World President, but he politely turns it down – because he did not want to give up real power!

The 'CNN Effect' played a part in inspiring global aid flows to the Indian Ocean rim countries that were devastated by the tsunami of December 2004. Clarke -- whose diving facilities were also destroyed in the disaster – readily offered free advice to governments, relief agencies and the media in the days and weeks that followed.

While strongly believing in the problem solving potential of science and technology, Clarke was well aware of the socio-economic disparities that prevented many people from accessing or benefiting from ICTs.

Legacy Continues

For 23 years (1979 – 2002), Clarke was chancellor of Sri Lanka's University of Moratuwa which trains most of the country's engineers and architects. This ceremonial position entailed presiding over the annual convocation, but in his own right, Clarke was a designer of the future and a 'builder of bridges' – between hardcore science fact and credible science fiction, and between knowledge and imagination.

During his illustrious career spanning over 60 years, Sir Arthur C Clarke received a large number of honours, awards and accolades from scientific, academic and literary bodies worldwide. At one time or another, he won all the top science fiction literary awards. He received honorary doctorates from universities in the east and west. In 1998, Queen Elizabeth II knighted him for his 'services to literature'. In his adopted homeland of Sri Lanka, where he lived 52 of his 90 years (1956 to 2008), he received the highest presidential honour for science (Vidya Jyothi, 1986) and the highest civilian honour (Lankabhimanya, 2005).

The legacy of Arthur C Clarke lives on – in his many books, and through the many people whose imagination he sparked.

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[Science writer Nalaka Gunawardene worked with Sir Arthur C Clarke from 1987 to 2008 as his research assistant and media coordinator.]