SPACE CHRONICLE

THE BRITISH INTERPLANETARY SOCIETY JOURNAL OF SPACE HISTORY

VOLUME 73 APRIL 2020

Hubble at 30

THREE DECADES IN SPACE AND STILL GOING STRONG

SOVIET AND RUSSIAN NUCLEAR SPACECRAFT

THE US NAVY'S SPACE SHIP

CHINA AND JAPAN EYE UP THE MOON

SPACE CHRONICLE

THE BRITISH INTERPLANETARY SOCIETY JOURNAL OF SPACE HISTORY

Letter from the Editor

Welcome to the new-look SPACE CHRONICLE, with its fresh design and focus on international aspects of space history across the decades. Published quarterly, in January, April, July and October each year, forthcoming issues will include in-depth features on rockets and spacecraft, early politics and space infrastructures, and human and robotic operations. As the magazine develops, each full-colour 40-page issue will also cover the space sciences and engineering, and investigate obscure developments and failed projects as well as the successes. There will be reviews of new and second-hand space history books, a section for your letters, a look back at key events from over a century of space history and much more.

SPACE CHRONICLE is first and foremost a magazine for all those with a passionate interest in how the global space programmes of today came to be. And, as we know, present-day activities and visions of the future very quickly become tomorrow's history, providing yet more fertile ground for future issues of the magazine to explore and share with other readers.

Readers are warmly invited to contact the Editor about writing features for SPACE CHRONICLE and we're especially keen to provide an outlet for new and emerging talents to publish their research – much as the present editor Editor was able to do back in the 1970s. Mike Bryce, who wrote this issue's feature article on the 30th anniversary of Hubble is one such author who has taken up that opportunity in this issue. So, please read on and I look forward to your feedback and participation with the BIS in this new and exciting voyage through annals of international space history.

David J. Shayler FBIS
editorchronicle@bis-space.com

About your editor
Space flight historian David J. Shayler was born in England in 1955. After leaving school, he trained as an engineering draughtsman prior to serving in HM Forces Royal Marines. After returning to civilian life, he worked in a variety of roles in the retail industry for over 20 years before becoming a full-time writer.

David's life-long interest in space began with drawings of rockets at the age of five but it was with the launch of Apollo 8 in December 1968 that it became a passion. He fondly recalls staying up all night with his grandfather to watch the Apollo 11 Moonwalk.

David joined the British Interplanetary Society (BIS) in January 1976, becoming an Associate Fellow in 1983 and a Fellow in 1984. Over the past 20 years he has sat, at various times, on the Society's Education, History, Library (including a term as its Chairperson), Membership and Publications Committees. From 2013 to 2019 he also served as a Member of the Council of the BIS and since 2012 he has coordinated the annual Sino-Russian Technical Forum.

The BIS published the first of David's articles in *SpaceFlight* during the late 1970s and in 1982 he created Astro Info Service (**www.astroinfoservice.co.uk**) to focus his research efforts. His first book was published in 1987 and has been followed by almost 30 other titles, including works on the U.S. and Russian space programmes, spacewalking, women in space, and the human exploration of Mars. His authorized biography of Skylab 4 astronaut Jerry Carr was published in 2008.

OUR MISSION STATEMENT

The British Interplanetary Society promotes the exploration and use of space for the benefit of humanity, connecting people to create, educate and inspire, and advance knowledge in all aspects of astronautics.

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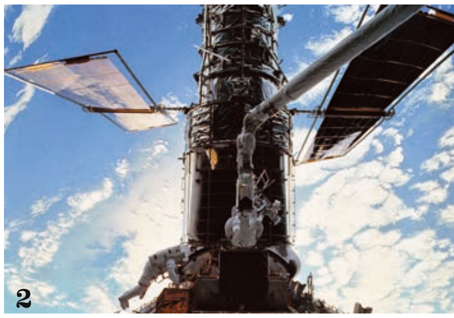
On the cover: 30 years ago, on April 25, 1990, the Remote Manipulator System (RMS) of *Discovery* releases the Hubble Space Telescope, captured here in an IMAX® frame still, with a cloudy blue Earth reflected in the closed Aperture Door.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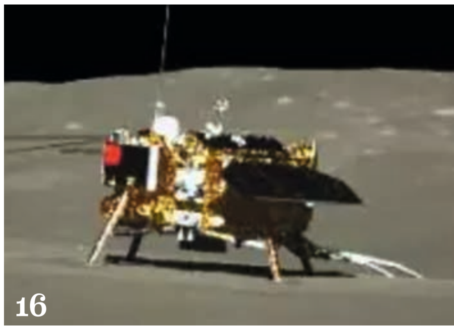
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Contributors to this issue

Mike Bryce first became interested in astronomy while at school and since 1993 has edited the Midland Spaceflight Society magazine *Capcom*. Professionally, he started as a draftsman before joining British Rail's Civil Engineering department in 1990. After 28 years in the rail industry he took early retirement to follow his primary interests of astronomy, space exploration and photography.

Philip Mills served in the Royal Air Force, working on V-Bombers and surface-to-air missiles. Nowadays he combines an interest in space exploration with a fascination for modelling, which led him to build scratch-built models of the early Soviet orbital space stations and even took him to the Pentagon, where he gave a talk to high-ranking members of the National Security and Space Office.

Dwayne A. Day is a senior program officer with the Aeronautics and Space Engineering Board of the National Academies of Sciences, Engineering, and Medicine in Washington, DC. He writes frequently on the history of intelligence collection on the Soviet space programme, U.S. satellite reconnaissance, and American civilian space programmes – both human and robotic.

Vadim Zakirov is a technical expert for Commercial Space Technolgies (CST) who has published more than 30 papers. He has a BSc in Aerospace Engineering from the Moscow Aviation Institute, an MSc in Aerospace Engineering from the University of Florida at Gainesville, and a PhD from the University of Surrey. Vadim worked as an Associate Professor for 10 years at Tsinghua University in Beijing.

Brian Harvey is a writer and broadcaster on spaceflight who lives in Dublin. He has a degree in history and political science from Dublin University (Trinity College) and an MA from University College Dublin. His first book was *Race into Space – the Soviet space programme* (Ellis Horwood, 1988), followed by over a dozen books for Springer/Praxis on the Russian, Chinese, European, Indian and Japanese space programmes.

NASA

NASA

ABOVE
Hubble in Earth orbit pictured from the Space Shuttle.

LEFT
The space telescope is successfully deployed from the payload bay of the Shuttle *Discovery*, 25 April 1990.

HAPPY BIRTHDAY HUBBLE

30 YEARS EXPANDING OUR KNOWLEDGE OF THE UNIVERSE

On 24 April 1990, NASA launched the Space Shuttle *Discovery* on a mission to expand our knowledge of the heavens. The Hubble Space Telescope (HST), billed as the largest telescope to be placed in Earth orbit at the time, would come to revolutionise our current understanding of the Universe. But it was not without its problems.

by **Michael Bryce**

For centuries, mankind looked to the stars and wondered; and for centuries, those views of the heavens were marred by the Earth's atmosphere. Many astronomers thought that it would be possible one day to place a telescope in orbit, above the atmosphere, and have the sharpest and clearest possible view of the heavens.

In 1923, Hermann Oberth – considered a father of modern rocketry, along with Robert H. Goddard and Konstantin Tsiolkovsky – published *Die Rakete zu den Planetenräumen* ("The Rocket into Planetary Space"), which mentioned how a telescope could be launched into Earth orbit by a rocket.

Then, in 1946, the astronomer Lyman Spitzer wrote a paper "Astronomical advantages of an extra-terrestrial observatory". Spitzer discussed the two main advantages that a space-based observatory would have over ground-based telescopes. First, the angular resolution (the smallest separation at which objects can be clearly distinguished) would be limited only by diffraction rather than by the turbulence in the atmosphere, which causes stars to twinkle and is known to astronomers as seeing. At that time, ground-based telescopes were limited to resolutions of 0.5–1.0 arc seconds, compared to a theoretical diffraction-limited resolution of about 0.05 arc seconds for a telescope with a mirror 2.5 m in diameter. Second, a space-based telescope could observe infrared and ultraviolet light, which are strongly absorbed by the atmosphere.

»

« During his devoted career, Spitzer pushed for the development of a space telescope. In 1962, a report by the U.S. National Academy of Sciences recommended development of a space telescope as part of the space program, and in 1965 Spitzer was appointed as head of a committee given the task of defining scientific objectives for a large space telescope.

Astronomy from space was in its infancy after the Second World War. Scientists made use of developments in rocket technology and in November 1946 the first ultraviolet spectrum of the Sun was obtained with an instrument on board a Sounding Rocket (an instrument-carrying rocket designed to take measurements and perform scientific experiments during its sub-orbital flight).

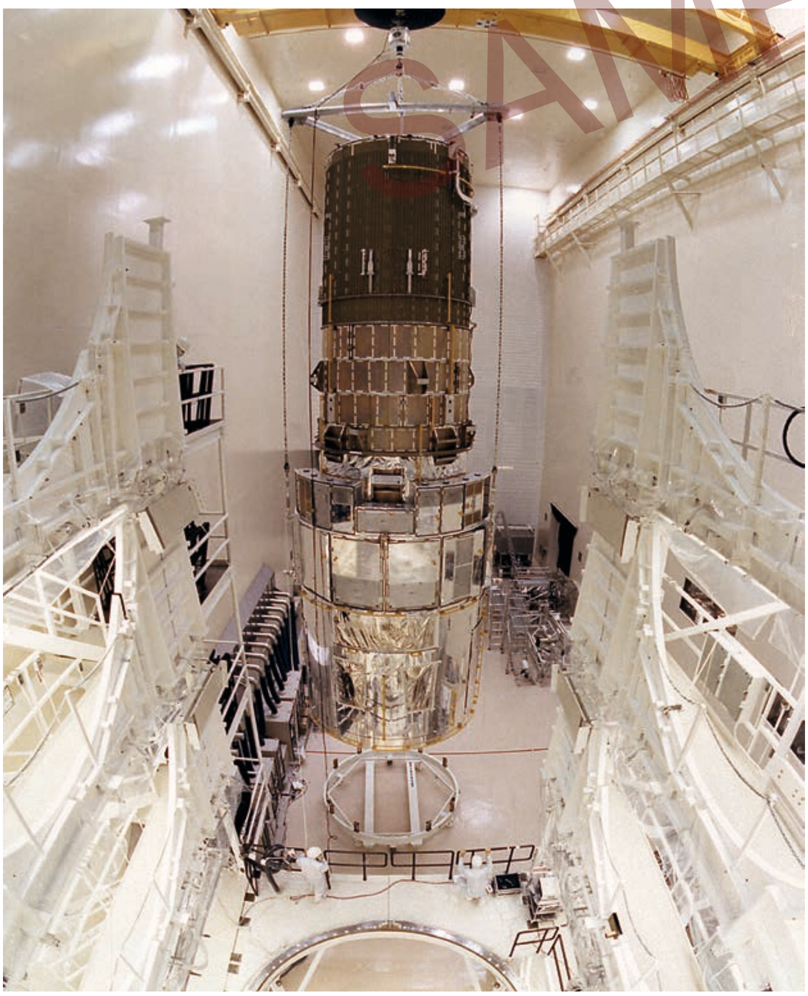
The first dedicated space-based solar observatory was launched in 1962 by NASA. The Orbiting Solar Observatory (OSO) was designed to obtain UV, X-ray, and gamma-ray spectra. Also in 1962, the United Kingdom launched an orbiting solar telescope as part of its Ariel space program. NASA launched the first Orbiting Astronomical Observatory (OAO) in 1966.

Although the first OAO suffered battery failure after just three days which terminated the mission, OAO-2 was a success, carrying out ultraviolet observations of stars and galaxies from its launch in 1968 until 1972,

ALL IMAGES: NASA

ABOVE
Namesake: the astronomer Edwin Hubble (1883-1953), who is credited with the discovery that what were once thought to be clouds of dust were, in fact, galaxies of stars far beyond our own.

BELOW
Hubble at Cape Canaveral being prepared for launch – delayed for four years by the *Challenger* disaster.



well beyond its original planned lifetime of one year. Although these spacecraft observatories were limited to the technologies of the time, including the size of their light-gathering mirror, the OSO and OAO missions demonstrated the important role space-based observations could play in the advancement of our astronomical knowledge.

In 1968, NASA began development of a space-based reflecting telescope with a mirror 3 m in diameter. Known provisionally as the Large Orbiting Telescope or Large Space Telescope (LST), with a launch slated for 1979, these plans emphasised the need for crewed maintenance missions to the telescope, to ensure such a costly program had a lengthy working life and that instruments and system parts could be replaced as technology advanced or when required.

In the 1970s, after the successful crewed missions of Apollo and Skylab, NASA focused attention on a reusable space Shuttle system that could deliver large payloads into Low Earth Orbit (LEO). As this Space Transportation System (STS) was being developed, the idea of developing a large space-based telescope which could be serviced by astronauts seemed a logical goal alongside the Shuttle system. In 1977, the American Congress approved the funding for the Large Space Telescope.

American astronomers outlined five principal objectives for the LST: "Explore the Solar System, measure the age and size of the universe, search for our cosmic roots, chart the evolution of the universe, and unlock the mysteries of galaxies, stars, planets, and life itself." Accomplishing such diverse objectives required a telescope that was capable of making minute geological observations of small asteroids and comets little more than a few hundred feet across on the one hand, while on the other hand studying and photographing super galaxy clusters billions of times larger than asteroids and comets in hopes of revealing the origins and destiny of the Universe.

The LST was constructed by NASA contractors Lockheed in Sunnyvale, California, while optics company Perkin

ABOVE The Chang'e 4 lander with its landing ramp deployed, pictured from the Yutu-2 rover – the first ground vehicle to explore the lunar far side.

A SHOT IN THE DARK

THE POLITICAL SIGNIFICANCE OF CHANG'E 4 LANDING IN VON KÁRMÁN CRATER

China's Chang'e 4 touched down on 3 January 2019 in von Kármán crater on the Moon's far side, becoming the first space vehicle to do so. But why was that exact site chosen in preference to the South Pole where future landings have been suggested?

by Philip Mills

Von Kármán is a 180 km diameter crater located within the Aitken Basin which is an impact crater 2,500 km in diameter. The Aiken Basin is 13 km deep and is one of the largest known impact craters in the solar system. Because the Aitken Basin extends over such a vast region and borders on the lunar south pole, including regions believed to contain ice, the Aitken basin has been described as the most valuable real estate in the solar system. However, the von Kármán crater itself is not at the south pole but it does have other politically symbolic reasons for why the Chinese chose to land there.

This paper was first presented at the BIS Sino-Russian Technical Forum in London on 1 June 2019.

HISTORICAL BACKGROUND

The founder of the Chinese space programme, Tsien Hsue Shen, won a scholarship in 1935 to study aeronautical engineering in the USA. He eventually ended up at Caltech's Guggenheim Aeronautical Laboratory in Pasadena, where he gained his PhD in 1939 under the guidance of the Austro-Hungarian mathematician, aerospace engineer and physicist, Theodore von Kármán. Von Kármán is regarded as one of the outstanding aeronautical theoreticians of the 20th century. A crater was eventually named in his honor on the lunar far side. In 1939, Tsien led a team at Caltech that developed a method of rocket-propelled take-off for bombers known as jet-assisted take-off, popularly referred to as JATO. Later, in 1944, the team helped to set up the Jet Propulsion Laboratory at Pasadena. At the end of the Second

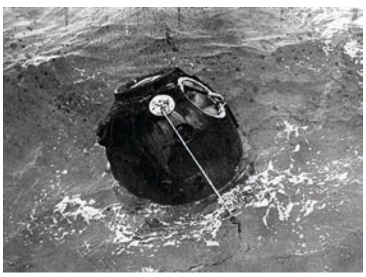
US NAVY

LITTLE BIG SHIP

THE US NAVY'S SPACECRAFT HUNTER

Built to hunt Soviet submarines during the Cold War, the USS *McNorris* ended up in search of far more exotic quarry – in the shape of Soviet spacecraft.

by Dwayne A. Day



S.P.KOROLEV RSC ENERGIA VIA NASA

P-D ART

ABOVE
A 10 kopek Soviet stamp issued to commemorate the achievements of Sergei Korolev, who briefly flirted with the idea of nuclear rocket propulsion in the late 1950s before embarking on the development of the conventionally fuelled N1.

BRIEF ENCOUNTER

SECRETS OF THE SOVIET UNION'S NUCLEAR SPACE PROGRAMME

At once time Soviet space engineers had high hopes for nuclear power – but in the end, the risks outweighed the benefits.

by Vadim Zakirov, Alan Perera-Webb, Gerald M. Webb and Constantine Milyaev, Commercial Space Technologies Ltd

The Soviet nuclear reactor spaceflight history involved 34 missions over 18 years. The nuclear reactors were used for spacecraft electric power supply. The nuclear reactors with two types of energy converters (thermoelectric and thermionic) were operated in orbit with average altitudes ranging from 250 to 990km. While spacecraft power plants with thermoelectric conversion had the longest in-orbit lifetime record of 135 days, the thermionic ones worked for up to almost a year. The progress made by the reactors with thermionic converters led to development of the next generation Topaz-2 space power plant with advanced specifications. Unfortunately, the further development of space nuclear power plants was halted by lack of finances during the break-up of the Soviet Union in the 1990s. The experience obtained during the programme led to the conclusion that the technological challenges limit electric power generation capacity for thermoelectric and thermionic conversions to kW level, so that MW-level space nuclear power systems must use turbo-machine conversion.

This paper was first presented at the BIS Sino-Russian Technical Forum in London on 1 June 2019.

INTRODUCTION

The present Russian MW power-class nuclear vehicle project for future space exploration missions [1-4] is a continuation of the earlier developments started by the former Soviet Union. [5-21] During the 1970s and 1980s, nuclear reactors could be found aboard a number of the Soviet reconnaissance satellites

ABBREVIATIONS

CPSU	Communist Party of the Soviet Union
IPPE	Institute for Physics and Power Engineering
JSC	Joint Stock Company
kW	kilo-watt
MW	mega-watt
NPS	Nuclear Power System
SAR	synthetic aperture radar
RORSAT	Radar Ocean Reconnaissance Satellite
TEG	thermoelectric generator
UN	United Nations
USSR	Union of Soviet Socialist Republics

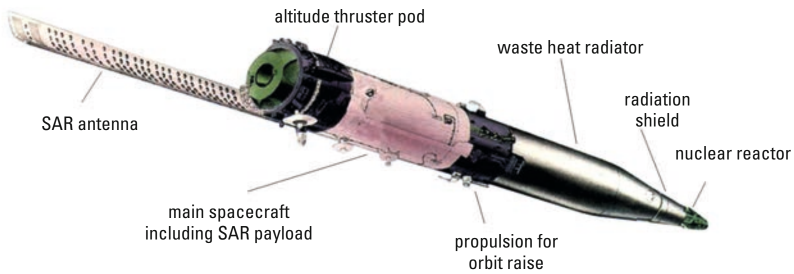
as electric power supplies. [6-9,13-16] The reconnaissance aimed at getting detailed all-weather imaging, primarily targeting military ships and their formations, as well as aircraft carrier groups. [14] Such imaging was delivered by synthetic aperture radars (SAR), which required kW-level electric power for their operation. For higher image resolution, the spacecraft's operational orbit was intended to be as low as possible, i.e. about 250 km. At such an altitude, the use of large solar arrays is impossible because the significant atmospheric drag would cause the spacecraft to de-orbit rapidly and re-enter the atmosphere. In addition, the specifications of solar cells and chemical batteries at that time were rather poor, making the whole system too large and heavy for the application. The consideration of alternative power systems for spacecraft demonstrated the superiority of nuclear reactor-based power supplies for the task, because they could be made more compact and lighter.

At the end of its mission, the reconnaissance spacecraft was injected into a disposal orbit. The disposal orbit is a circular orbit of 800-900 km altitude in which the reactor will remain long enough for decaying fission material radiation to reduce to an acceptable safe level – at least 10 half-lives of the most survivable radioactive isotopes – to ensure radiation safety.

SPACE NUCLEAR POWER SYSTEMS

The simplified schematic of a power system with a nuclear reactor on board a reconnaissance satellite carrying SAR is shown in Fig 1. The schematic illustrates the basic operating principle of how the nuclear power system was applied aboard a reconnaissance satellite. Heat generated by the nuclear reactor was transferred to a power conversion unit that transformed it to electricity. Electricity was used to power the main spacecraft payload, consisting of the SAR and the other subsystems. Unconverted heat was radiated into the space environment by a waste heat radiator.

For such an arrangement, power conversion is a key technology, because the converters determine the whole system's key specifications such as system weight, output electric power, lifetime, etc. Two types of converters were applied: thermoelectric and thermionic ones. Thermoelectric conversion relies on the application of a temperature gradient to p-n (positive-negative) type semiconductor pair, while in thermionics the gradient induces electron emission through the inter-electrode gap to generate electric power. Thermoelectric converters are typically placed outside the nuclear reactor core to protect them from radiation that degrades their performance. Thermionic converters are typically placed inside the reactor core because their performance is not affected by radiation. Within the reactor core, thermionic converters are exposed to a higher temperature gradient so that their conversion efficiency is higher than that of thermoelectric ones, although it is a challenge to keep a micro-meter scale inter-electrode gap inside a hot reactor core for a long time.



COURTESY VADIM ZAKIROV COLLECTION

FIG 2 (above) Principal features of the RORSAT US-A reconnaissance spacecraft. See Ref. [10].

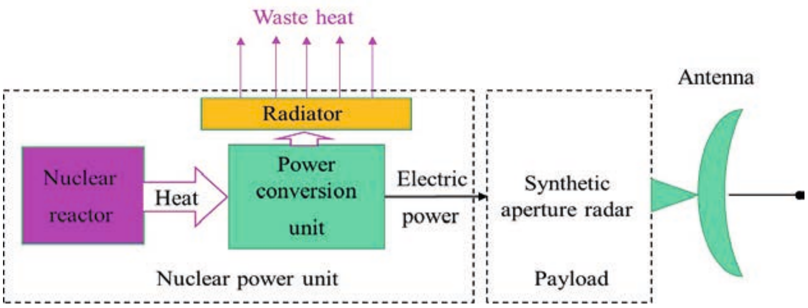
> " AT THE END OF ITS MISSION, THE RECONNAISSANCE SPACECRAFT WAS INJECTED INTO A DISPOSAL ORBIT "

SPACECRAFT

The spacecraft, shown in Figs 2, 3 and 4, carried onboard nuclear reactor power units. The spacecraft were the well-known RORSATs (Radar Ocean Reconnaissance Satellites). They were manufactured by the "Arsenal" design bureau and looked similar.

The RORSAT US-A spacecraft (Cosmos 954 type) shown in Fig 2 carried a Bouk nuclear power unit generating 2.5kW of electric power and had a rocket-like shape that would fit well under the launcher payload fairing. The nuclear reactor was placed at the cone tip. A shadow-type shield protected the rest of the spacecraft from radiation. A waste heat radiator radiated unconverted heat into the space environment. It also covered the reactor control actuators and power conversion system located inside. Propulsion for raising

FIG 1 (below) Principle schematics of a nuclear power system aboard a radar satellite.



JAXA

ONCE IN A BLUE MOON?

A review of the state of the Japanese lunar programme in 2019 to coincide with the 50th anniversary of the first Apollo Moon landing in July 1969. Japan was the third country to reach the Moon but its lunar programme subsequently fell back as the nation's space agency focused on other solar system objectives.

by Brian Harvey

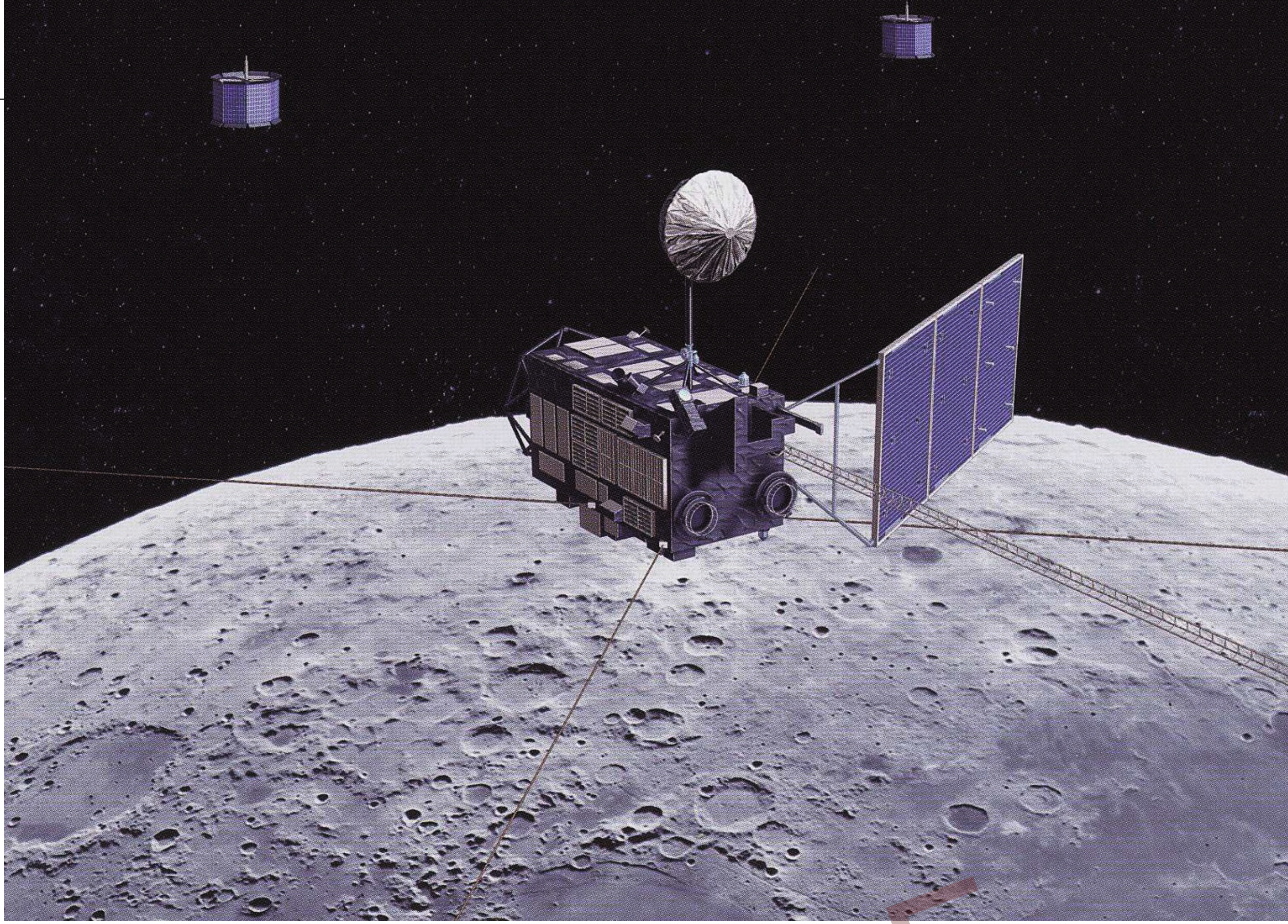
Under the guidance of chief designer Hideo Itokawa, Japan developed small solid-fuel rockets in the 1960s, enabling the country in February 1970 to become the fourth nation to orbit a small satellite, following the Soviet Union, United States and France, but ahead of China and India. In the mid-1980s, Japan was able to send two small spacecraft, Sakigake and Suisei, into the tail of Halley's Comet, so a lunar demonstration mission was the next logical step.[1]

Japan became the third country to reach the Moon, in 1990, following the Soviet Union and United States, the first lunar mission since Luna 24 brought samples back from the Sea of Crises in 1976. Launched on 24 January, this was a complex double mission that used a 54-day looping trajectory to reach the Moon, where a small 11kg lunar satellite, Hagoromo, was released into a 7,400 km by 20,000 km orbit on 18 March. Unfortunately its radio failed, but it demonstrated Japan's ability to reach the Moon. The 193 kg mother craft, Hiten, followed a trajectory back toward Earth and used aero braking to return to the Moon, where it entered an unstable 422–49,200 km lunar orbit on 15 February 1992, which led to impact at 38°S, 5°E, on 10 April 1993.

Japan moved on to its next Moon project, the purpose of which was to obtain a substantial

This paper was first presented at the BIS Sino-Russian Technical Forum in London on 1 June 2019.

ABOVE
Earthrise as pictured in a low horizon shot from Japan's Kaguya lunar spacecraft.



JAXA

« scientific return. Called Lunar A, this was an orbiter that would drop penetrometers with seismometers to detect seismic activity and heat flow probes to measure the thermal environment below the lunar surface. It was a sophisticated project with an extensive testing phase and went through multiple evolutions, but was eventually abandoned as too complex and expensive.

The next Moon probe, SELenological and ENgineering Explorer, or SELENE, was already in development and was a happier story. It was finally launched on the powerful H-IIA rocket on 14 September 2007, the first country out of the gates in the 'great Asian Moon race' that year, to be followed by China's Chang' e 1 and India's Chandrayaan 1. Following standard Japanese practice, SELENE was renamed, being called Kaguya. It took a slow trajectory to reach the Moon on 4th October 2007, entering an initial orbit of 101–11,741 km, later adjusted to an operational orbit of 80–123 km. On arrival in lunar orbit, Kaguya dropped off two sub-satellites, Okina and Ouna.

Kaguya, with 14 instruments, was a

ABOVE
An artist's impression of the Kaguya spacecraft in orbit around the Moon.

BELOW
The long-delayed Smart Lander for Investigating Moon (SLIM), now due to launch in 2021.

JAXA

TalkSPACE...


With Gerry Anderson's STINGRAY • FIREBALL XL5 • SUPERCAR

TV CENTURY 21

7D

ADVENTURE IN THE 21st CENTURY

No. 1 UNIVERSE EDITION — EVERY WEDNESDAY — DATELINE: January 23, 2065

STINGRAY LOST!

Steve Zodiac Dead?

REPORTS were flashed to Space City early today of the death of Colonel Steve Zodiac! The Fireball XL5 astronaut is believed to have been investigating a mystery centred around a space freighter.

Commander Zero, Chief Controller at Space City, said he could neither confirm nor deny the report, and that a statement would be issued later.

See Page 4 for full story.

TITAN TERROR FISH ATTACKS WASP VESSEL

MARINEVILLE, WEDNESDAY: Battle Stations was drummed out at Marineville today when the World Aquanaut Security Patrol was put on an invasion standby.

The alert was called when WASP's chief, Commander Shore, reported a complete loss of radio contact with the patrol vessel Stingray.

The last message from Stingray's Captain Troy Tempest told of a Titan Terror Fish attack. Since that fateful moment, Marineville has been at Emergency Red.

Stingray's loss will put the WASP's at a disadvantage in the conflict with Titan and his underwater people.

For Full Colour Videoscan Report—See page 10.

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CORGI MODEL CLUB NEWS – Page 19

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"I wish I was a spaceman, the fastest guy alive..."

Sir,

Dateline: January 23, 2065.

In actual fact, it's 1965, and thus began a brand new weekly British children's comic *TV Century 21* (or **TV21**, as it came to be more commonly known), published by City Magazines during the latter half of the 1960s. It promoted the many science-fiction television series created by the Century 21 Productions company of Gerry and Sylvia Anderson. The comic was published in the style of a newspaper of the future, with the front page usually dedicated to fictional news stories set in the worlds of *Fireball XL5* (the first line from the catchy theme tune is reproduced above), *Stingray*, *Thunderbirds*, *Captain Scarlet and the Mysterons* and other stories. It ran from January 23 1965 to September 25 1971.

Within the first 51 issues (that I know of), there was a series of articles entitled "The Truth About Space" written between 1965 and 1966 by "Roger Dunn, member of the British Interplanetary Society".

Unfortunately no records or details are available about this person, but his articles covered a wide range of 'real' space topics for the time – docking techniques, spacesuit design, astronaut training, quasars, moon bases, space junk, space stations, comets & asteroids, planets of the Solar System, with many illustrations by renowned space artist and long-time BIS Fellow David A. Hardy FIAAA. There were also individual profiles of the (few) astronauts and cosmonauts of the time.

Dunn even makes a direct reference to the BIS in issue no.8, entitled "Space Eyes" (March, 1965), where a special BIS award was given to physicist Dr William H. Pickering of JPL for his contribution to the exploration of space, specifically, the Mariner and Ranger spacecraft programmes. Regrettably, *TV Century 21* issue no.10 is missing from this archive.

You can see my collection of these articles on my Pinterest pages: **https://www.pinterest.co.uk/salmon0655/tv21-truth-about-space-articles/**

Steve Salmon FBIS
(steve.salmon@bis-space.com)

ABOVE RIGHT
The first issue of *TV Century 21*.

BELOW
The ski ramp-launched Fireball XL5 departs Space City on another mission on behalf of the World Space Patrol – located on an unnamed island "somewhere in the South Pacific".

WWW.LISTAL.COM

***Editor's Note:** As an enthusiastic nine year old when TV21 first appeared I have fond memories reading the adventures set a century in the future each week, inspired by the imagination of Gerry Anderson, and watching the 30-50 minute early evening programmes mentioned above on our small black and white TV. For me Fireball XL5, which first aired in 1962/1963, more than anything else 'launched' my young imagination into the possibilities of space travel. To have, in TV21, a blend of factual articles and escapism stories only enlightened this interest which by the end of the decade led to an avid following of the 'real' space programme, a passion which has never ceased, over 50 years later. Even now the early Anderson programmes remain nostalgic viewing*

ShelfSPACE...

Chronicle, according to the dictionary, relates to "a factual written account of important or historical events in the order of their occurrence." In terms of space exploration this has, for most of us, meant collecting our own library of books documenting aspects of space exploration which fascinate us. Archived within a wealth of news releases, magazine articles, reports, images and memorabilia, their origin in the collection is fondly recalled in our memories. Expanded over many years, our own personal, space library is much treasured with each title fondly thumbed and our favorites taking pride of place on our bookshelves. In an era of digital downloads and social media platforms, the wonder and enjoyment of turning each page in a real book remains, and while the internet can offer instant access to a wealth of reading material, the fun of owning and reading hard copy books still attracts.

As we embark on this new format of Space Chronicle in this regular feature we take the opportunity to look back and reflect on those books which have been milestones in our personal journey into space, if only through the words and images they spread before us. In this first feature the Editor reveals a personal connection between one of the first books in his collection, a long association with the Society and his own writing career. In future issues we will explore new and archival titles, endeavour to learn more about readers' own collections, and review the broad range of books that have become synonymous with key events throughout space history.

David Shayler

Oldie but goldie

It was during the closing months of 1968, that our class teacher tasked us to produce a '3rd year-project' to be delivered by the end of spring term 1969. As a 13-year old facinated by spaceflight, the choice of topic for me was easy – The Apollo Lunar Program.

I had become intrigued with the prospect of landing men on the moon after watching TV reports about the Apollo 7 mission. Routinely pasting newspaper clippings in a scrap book, I was looking forward to the next mission – Apollo 8 which would take the first astronauts around the Moon and, I thought conveniently, right over the Christmas holidays from school.

Eager to conduct some research in the school library beforehand I found a new copy of *Manned Spacecraft* by Kenneth Gatland and was enthralled by its 80-page coloured section , and an additional 150 pages describing the first decade of human spaceflight. Published in 1967 this book, I read, was part of the "Pocket Encyclopaedia In Colour" series by Blandford Press that would subsequently include the titles Frontiers of Space and Robot Explorers by the same author. So enthralled by the modern presentation I put the book at the top of my Christmas list for that year, and as a result it became the first 'space book' in my collection. From that book, my own space library, over the next five decades, has significantly increased in number, but that first book by Ken Gatland, remains pride of place in my collection.

For this teenager, the exciting mission by mission accounts in *Manned Spacecraft* opened up the stories of both the American and also the then Soviet manned space programmes, igniting a desire to find out more and a passion for human space exploration that has never waned. Thanks in part to the superb artwork by John W. Wood

Pocket Encyclopaedia In Colour: Manned Spacecraft

Kenneth Gatland

Blandford Press, 1967, 256 pages, illustrated

and Tony Mitchell, who like Ken Gatland had previously worked at Hawker Aircraft, also attracted me as at the time I was intending to become an apprentice engineering draughtsman once I left school. The book was so popular it would be revised at least twice with an updated 2nd edition published in 1976.

I was so taken with the book that, from the dust jacket I read that Kenneth Gatland was the Vice-President of the rather futuristically named British Interplanetary Society, was a "foremost authority on space exploration" authoring of several books on the topic and the current "editor of the magazine *Spaceflight*". So in this one book

BackSPACE...

HISTORY LESSONS

SPACE CHRONICLE'S EVOLUTION OVER THE YEARS

This is the third era of the BIS *Space Chronicle* magazine, which was initially published as part of the JBIS family between August 1980 and July 1986 under the editorship of Andrew Wilson. Its widely read articles were aimed at a more general level than the more formal content found in the pages of JBIS. Then, from August 1981, the short-lived and irregular *Astronautics History* added to the BIS portfolio as a second outlet for features from space history. Supplementing the *Space Chronicle* from February 1982 was the increasingly popular *JBIS Soviet Astronautics* series, edited by the late Rex Hall. For over 20 years, this published papers from the popular annual Soviet Technical Forum, which is now known as the Sino-Russian Technical Forum and this year celebrates its 40th anniversary.

After a gap of 15 years, a re-launched *Space Chronicle* was introduced, edited by John Becklake. Between 2002 and 2019, the new version retained the character of the original format, but introduced features that recorded important historical aspects of worldwide space activities, topics of more general interest and papers presented at the Sino-Russian Forum.

History has always been an integral element of the BIS, but over the years has required new outlets to do the topic justice. As explained in the first issue of *SpaceFlight* in October 1956, the venerable *JBIS Journal* had been published since 1934 and the papers contained within had "been of considerable value to research workers." The membership at that time became divided between *JBIS* being too technical or not technical enough. The solution, on the eve of the space-age, was to create a new, more popular magazine called *SpaceFlight*. Here, a clear picture of current research could be presented, as well as "discussing historical matters," and for over 60 years the magazine has achieved that admirably under the guidance of a series of Editors, from Patrick Moore in 1956 to current incumbent David Baker. But once again the time is right for expansion in the publishing portfolio of the Society. This new, re-designed *Space Chronicle* will become the premier space history publication within the BIS, while *JBIS* continues its 75-year plus pedigree of technical features and *SpaceFlight* focuses upon current operations and future developments. SC *David Shayler*

TIMELINES

SELECTED MILESTONES FROM THE CHRONICLE OF SPACE HISTORY [April – June 2020]

Years ago	Year	Date	Event
100	1920	6 April	Birth of Anatoli I. Savin (1920-2016); became a specialist in (military satellite) information and automatic control systems; and later the Chief Designer of KB-1 and TsNII Kometa.
95	1925	1 May	Birth of Scott Carpenter; NASA Original 7 Astronaut (1959); pilot Mercury-Atlas 7 (1962) & USN Sealab aquanaut (1965).
90	1930	17 May	Max Valier, 35, Austrian rocketry pioneer, is killed when an alcohol-fuelled rocket exploded on his test bench.
85	1935	31 May	A Robert Goddard 'A' series rocket reached 2.28 km.
80	1940	9 April	Birth of Vasily D. Shcheglov; Soviet pilot cosmonaut (1965-1972) who was medically retired before he could fly in space. Shcheglov died of cancer on 16 July 1973.
75	1945	13 June	Birth of Ronald ('Ron') Grabe, NASA Pilot astronaut (1980-1994) who flew on four shuttle missions, twice as a Pilot and twice as Commander.
70	1950	5 May	X-1 flight 133; Pilot Jack Ridley, investigated buffeting, wing and tail loads on the aircraft.
65	1955	6 April	X-2 Flight 6. Pilot Pete Everest. A glide flight; the X-2 (#46-674) became unstable on landing resulting in damage. It was subsequently returned to Bell Aircraft for landing gear modifications.
60	1960	1 April	Tiros 1 (Television Infrared Observation Satellite) was launched; the first successful low-Earth orbital weather satellite.
55	1965	3 June	Edward H. White II, Pilot Gemini 4, becomes the first American to walk in space (20 min).
50	1970	14 April	The oxygen tank #2 failure in Apollo 13's Service Module aborts the third moon landing mission two days into the flight, resulting in an intense three-day journey back to Earth.
		24 April	Dongfanghong 1('The East is Red 1') China's first satellite is launched by a Chang Zheng 1 (Long March 1) launch vehicle.
		19 June	Soyuz 9 (Andrian Nikolayev and Vitaly Sevastyanov) descent module lands after a flight of 17 days, 16 hours, 58 minutes, 55 seconds, setting a new human spaceflight endurance record. Five decades later Soyuz 9 remains the longest crewed flight by a solo spacecraft.
45	1975	5 April	Soyuz 18-1 (Vasily Lazarev and Oleg Makarov) became the first launch abort with a crew on board, after the launch vehicle's third stage failed to separate from second stage of the carrier rocket resulting in a 20+G entry and an emergency landing 22 minutes after launch.
40	1980	9 June	Soyuz T-2 (Yuri Malyshev and Vladimir Aksyonov) lands following a successful four-day and first crewed test flight of the improved Soyuz ferry craft to the Salyut 6 space station.
35	1985	24 June	STS-51G (Discovery) lands at Edwards AFB, California after a successful 8-day satellite deployment mission.
30	1990	7 April	Hubble Space Telescope is deployed by RMS from Discovery (STS-31).
25	1995	1 June	Spektr (Spectrum) module is automatically docked to the Mir space station. The module was equipped for remote sensing of Earth's environment.
20	2000	22 May	STS-101 (Atlantis, ISS flight 2A.2a) crewmembers Jeff Williams and James Voss conduct a 6 hour 44 minute EVA to install the final parts of the Russian built crane, replaced a faulty antenna and installed some handrails and a camera cable outside the embryonic ISS.
15	2005	16 April	Cassini completes its fifth planned close-fly by (1,025 km) of Saturn's moon Titan to gather data on the constituents in the upper atmosphere.
10	2010	2 April	Launch of Soyuz TMA-18 (22S), carrying the ISS E023/24 crew (Alexander Svortsov, Mikhail Kornienko and Tracy Caldwell Dyson) to the ISS. (4 April) TMA-18 docked at the Poisk docking port on the space station.
5	2015	28 April	Launch of Progress M-27M (59P) to ISS. A planned docking 6 hours into the mission was aborted due to a failure of the upper stage of the Soyuz-2.1a launch vehicle prior to separation of Progress, leaving it spinning and not fully controllable. Deemed a total loss, Progress M-27M performed a destructive re-entry on 8 May 2015.