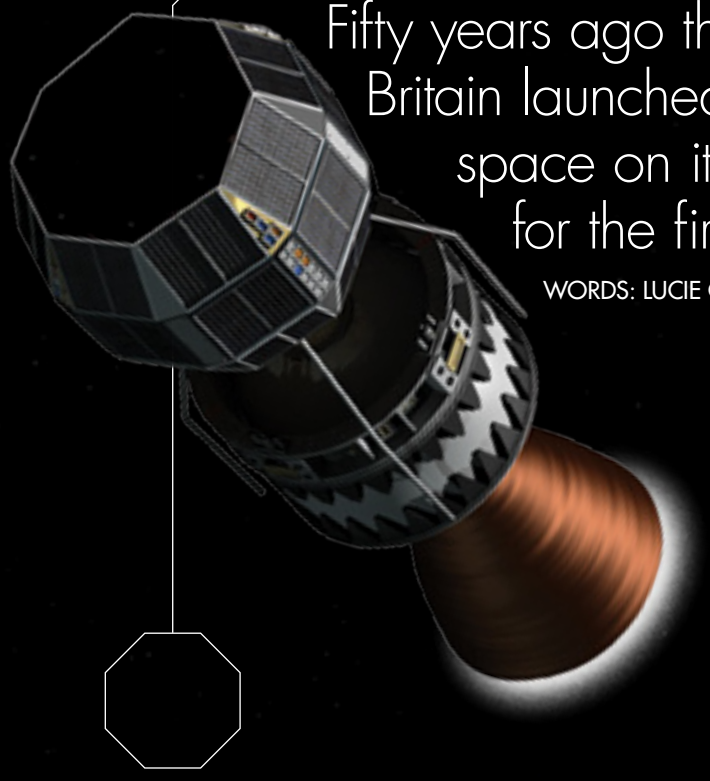
The one and only

Fifty years ago this month Britain launched a satellite to space on its own rocket for the first and last time

WORDS: LUCIE GREEN

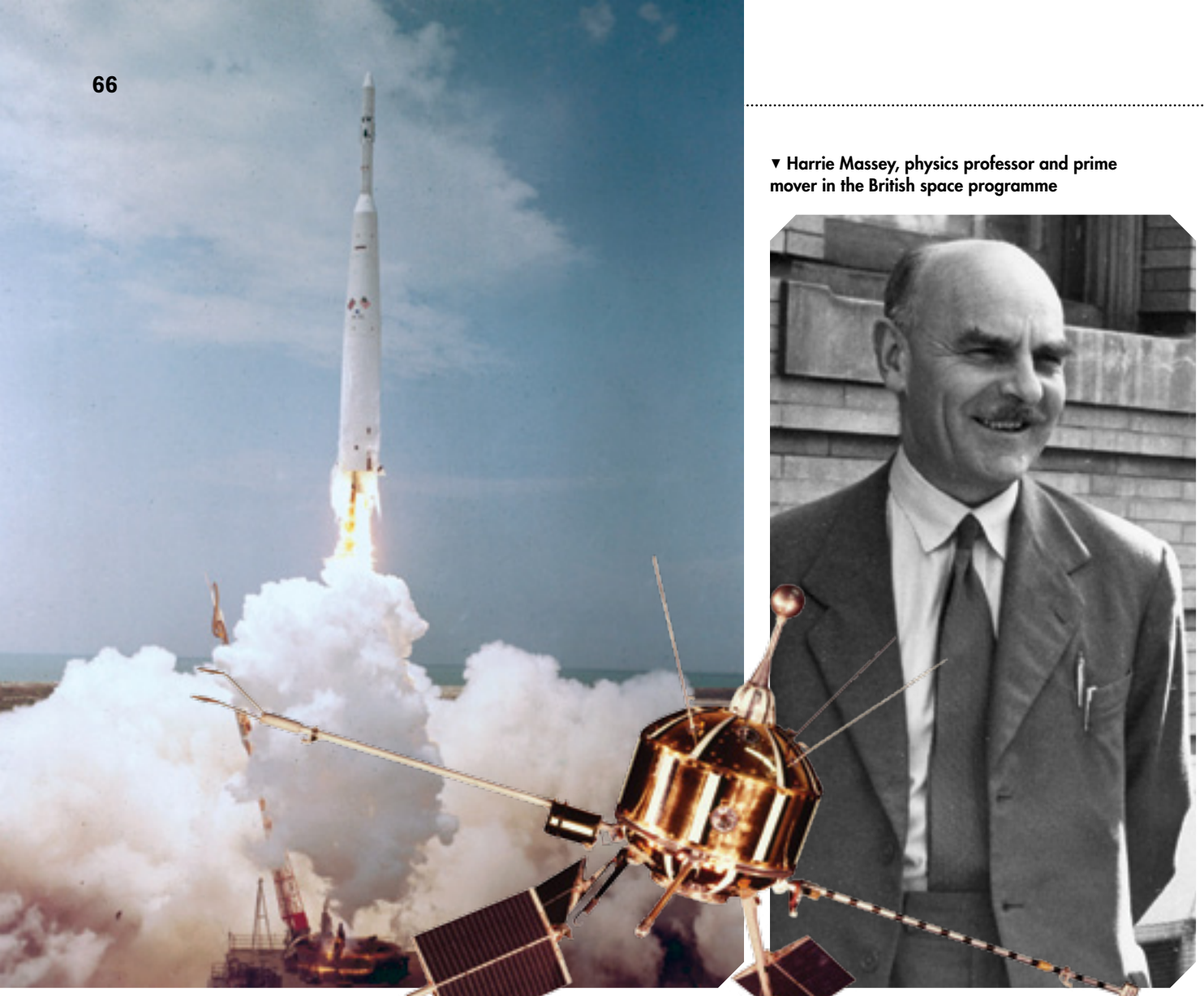


On 13 May 1953 the Head of Physics at University College London, Sir Harrie Massey, received a phone call. This call made him late for the departmental cricket match but it was to be extremely worthwhile: it marked the beginning of the British space research programme.

In the early 1950s there were a large number of UK scientists studying the Earth's upper atmosphere and it was becoming apparent that the rockets being developed for the national defence programme could be used to great advantage in this research area. The phone call that Massey received was from the Ministry of Supply, who were offering rockets for use in scientific research. Massey immediately accepted. ▸

NICK STEVENS

An artist's impression of the Prospero satellite and its third stage separating from the Black Arrow rocket



▼ Harrie Massey, physics professor and prime mover in the British space programme

▲ A US Thor-Delta rocket launched the Ariel 1 satellite, inset, to space in 1962

► Across the Atlantic, American scientists had already established a rocket research programme and in 1953 an international conference was held in Oxford to discuss progress so far. The talks by US scientists stimulated the British and led to a successful funding application to the Treasury. These funds would enable the Ministry of Supply to provide rockets and British universities to build instruments to take into space.

Joint effort

Strong links were being forged between the US and UK as a result of the work of Massey in the 1950s and '60s, so when NASA put out a call for international co-operation the UK was ready to respond. The programme that followed was known as 'Ariel' – a joint undertaking between NASA, who would supply the satellite and launcher, and the UK, who would supply instrumentation. Initially, three satellites were planned but this later became six.

As a result of this programme Ariel 1 was launched in 1962 to become the world's first international satellite. Ariel 2 was built and launched successfully along the same lines in 1964, but in the run-up to Ariel 3, NASA decided that there needed to be a major change in the division of responsibilities. The Americans felt that they could no longer be responsible for the design and construction of the satellite and that this should now be done by the UK.

Ariel 1 was launched in 1962 to become the world's first international satellite

Ariel 3, launched on 5 May 1967, was therefore an important milestone for the UK: it was the first satellite completely designed and developed by Britain, and it was a success. After Ariel 3, the scene was set for the UK to go one step further: it was time to launch a British satellite on a British rocket.

The Black Arrow rocket was to be the UK's satellite launch vehicle, but it had an inauspicious beginning. The first test launch of the rocket in 1969 was a failure, but success came in 1970 with a textbook launch. It was now time for the UK to launch its first satellite, called Orba. Orba was a very simple body – a 13.6kg sphere designed to study the atmosphere by monitoring how its orbit decayed due to atmospheric drag. But the Black Arrow's second stage shut off early and the launch, on 2 September 1970, failed.

Satellite scientists Len Culhane

Len Culhane worked on the Ariel 1 satellite. He is professor of physics at UCL and was director of the Mullard Space Science Laboratory from 1983 to 2003

"At the start of my career at University College London I was involved in the Skylark sounding rocket programme, using the instruments on board to study solar radiation. In those days the experiments were simple and the process informal, which meant there could be a fast turnaround between launches. This was good for progress and also meant that I regularly spent time at the launch site in Woomera, Australia.

For my PhD I worked on the proportional counter for the Ariel 1 satellite under the supervision of a pioneer of British space science, Robert Boyd. It demonstrated for the first time that the Sun's X-ray spectrum hardened during solar flares and was due to emission from high-temperature gas.

The Ariel 1 satellite represented the first international space programme of any kind. Also, the combination of university groups from across the UK working with industry on Ariel is a model that we still follow today. Prospero, as the first solely UK spacecraft, was enabled by this experience.

When the UK cancelled its launch programme, scientists continued to launch their instruments with the US. This meant that we weren't negatively affected scientifically, although of course commercially it caused a setback for the UK. The establishment and tradition of building hardware in UK universities, with an enabling role by collaborations with NASA, was set by Ariel and Prospero. It enabled UK groups to learn the trade and become internationally competitive."

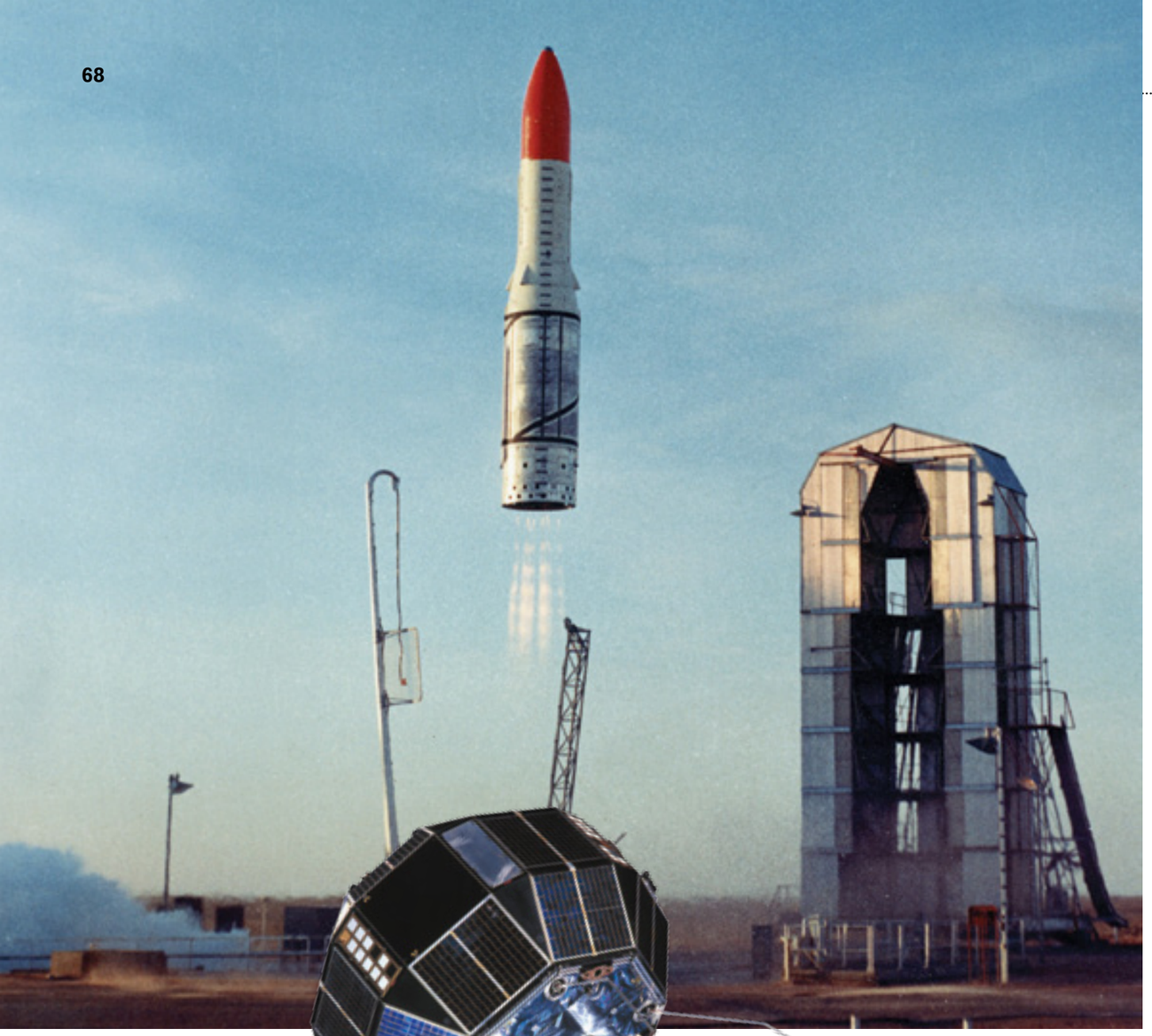
► Orba was to be Britain's first satellite but its Black Arrow launcher failed to put it in orbit

The work continued and on 28 October 1971 the Prospero satellite was successfully launched from Woomera, South Australia. The 66kg satellite was placed into an orbit with an inclination of 82° from the equator, circling the Earth once every 107 minutes, at a distance between 547km and 1,582km. Prospero had become the first and only UK satellite to be launched on a domestic rocket.

Solar power

The satellite, built at Marconi Space and Defence Systems in Portsmouth, was a mission with its eye on the future and was primarily a technology demonstration. Ultra-lightweight solar cells were tested as a means of meeting the increased power demands of future satellites, miniaturised electronics were tested for their resilience to the space environment and different surfaces were studied for longevity and thermal stability.

One scientific instrument was carried on board, however. It was known as the micrometeoroid experiment. Before rockets opened up our knowledge of space it was thought that our atmosphere simply faded out and that space was empty except for electromagnetic radiation. With the launch of the first sounding rockets, scientists quickly realised that, actually, impacts from small particles were occurring. Prospero carried an experiment to study the space environment and measure the rate of these particle hits. Prospero was also the first satellite to have its orbit monitored and controlled from the UK, requiring a satellite ►



▲ **The Black Arrow rocket carrying Prospero, inset, launches from Woomera, Australia**

NICHOLAS HILL/SPACEUK.ORG, SCIENCE AND SOCIETY PICTURE LIBRARY, PAGE 69 ILLUSTRATION BY PAUL WOOTTON

► control centre to be established. This was located at the Royal Aircraft Establishment (RAE) in Farnborough, where data from the ground stations was collected and satellite commanding, along with other operations, took place. The main ground station that directly received the radio signal from Prospero was the RAE station at Lasham. Official contact with Prospero continued until 2000, when Lasham was closed and the satellite monitoring systems were turned off.

An exclusive club

With the launch of Prospero, the UK became the sixth nation to put its own satellite in space on its own launcher after the Soviet Union, the United States, France, Japan and China. To date though, we remain the only nation to have successfully launched one, and only one, satellite. In fact, Prospero's launch went ahead despite the fact that the UK rocket programme had already been cancelled in July 1971. With the funding in place and the launch taking place in the Australian outback, it seems that the scientists kept their heads down and – luckily for the country – may have benefitted from being out of sight, out of mind.

It is sad for many to reflect on the cancellation of the UK's domestic launch programme. Today's common rocket launches and ubiquitous use of space technology mean it's easy to see with hindsight where the UK has missed out on commercial return. However, at the time that the Black Arrow was cancelled, the commercial applications of rockets were nonexistent. In this context, it is understandable why Edward Heath's administration felt it was better for the country to cancel the rocket programme, while continuing to fund the satellite technology programme.

Today, the challenges involved in producing a spacecraft that carries instruments built by different university groups are well understood: ►

Satellite scientists Phil Guttridge

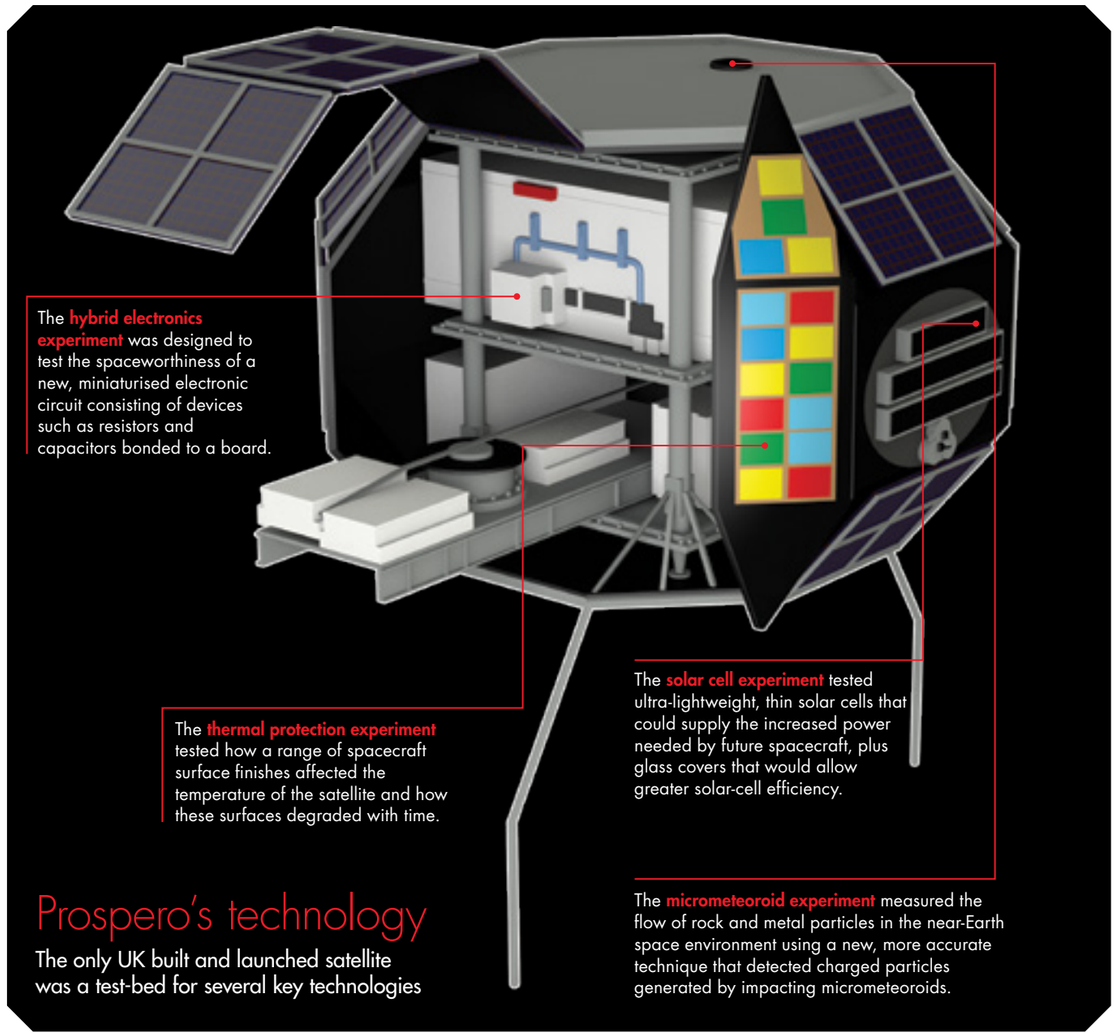
Phil Guttridge worked on hybrid electronics for the Prospero satellite. He is currently head of electronic engineering at Mullard Space Science Laboratory

"During the development of Prospero I was working in the Space Department at the Royal Aircraft Establishment in Farnborough. I was designing and building 'think-film' hybrid microcircuits, which was a way of miniaturising electronics and a step forward from printed circuit boards. I worked on the hybrid experiment on Prospero.

At that time people thought that hybrid technology was the direction that electronics assembly was going to take. Since then printed circuit-board technology has developed further than expected, so hybrids are not the only way to miniaturise.

After the launch of Prospero, I continued to work on space electronics and moved to the Mullard Space Science Laboratory (MSSL). There, I became involved in the Ariel programme. In 1979, the operational status of Ariel 6, the last in the Ariel series, was being corrupted – probably by a Russian radar. It was decided that a small ground station be set up in Canberra, Australia, to obtain data over more of the satellite's orbit.

While we were testing the ground station at MSSL before taking it to Australia, we received downlink telemetry that was on the frequency that we expected for Ariel 6, but which was much stronger and coming from a satellite with a different spin rate. It turned out that we were listening to Prospero! Ariel 6 had been made with the flight-spare telemetry and command subsystems from Prospero, and nothing had been changed between the two missions. This was the last time I heard from the satellite."



Prospero's technology

The only UK built and launched satellite was a test-bed for several key technologies

▲ **Prospero is visible from the UK with binoculars. This image of its trail was taken from Selsey, West Sussex in February**

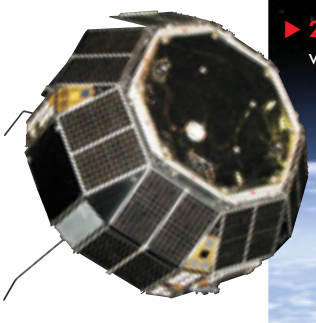
▸ the mass, power and size of the instruments are tightly constrained and they must operate without any inference between them. But in the 1960s this was a new experience: the lessons learned and the partnerships made led to a nation in which space science and engineering has flourished. The legacy of Prospero is that we continue to be a world leader in space science and small satellite manufacture.

Prospero is expected to stay in orbit above the Earth for another 60 years and while it's up there the UK will continue to explore the Universe. We now have a UK Space Agency to give better co-ordination and support for our science within Europe. Despite funding cuts, the UK is involved in some challenging and exciting new projects such as GAIA, a mission to map around a billion stars in the Milky Way and beyond, due for launch in 2013. There is also a thriving commercial space sector, with companies such as Surrey Satellite Technology and Clyde Space.

So, spare a thought for Prospero and the legacy it left for the UK. Maybe even take a moment to watch it passing overhead this month, shining at around mag. +6 (information on passes at your location can be found at www.heavens-above.com). As you watch Prospero move silently across the sky, don't forget that UK space science was initiated largely by the vision and dedication of one man – the late Sir Harrie Massey – whose acceptance of a phone call all those years ago delayed a cricket match but paid great dividends for the nation's space science.

PETE LAWRENCE, THINKSTOCK X 2

▼ **The UK's only self-launched satellite will remain in orbit for another 60 years**



READ MORE

Now turn to page 72 to read all about **Black Arrow**, the British rocket that launched Prospero

A brief history of the UK space programme

- **1953** Sir Harrie Massey is offered the use of rockets for scientific research.
- **1957-58** International Geophysical Year facilitates the largest international scientific collaboration up to that time and the UK launches its first scientific rocket.
- **1962-79** The UK co-operates with NASA on the Ariel programme of six satellites.
- **July 1971** The UK Government, under Edward Heath, cancels the Black Arrow launcher programme shortly before the launch of Prospero.
- **1975** The European Space Agency is founded when the European Space Research Organisation and the European Launcher Development Organisation merge. The UK is a founder member.
- **1985** The British National Space Centre (BNSC) is formed to co-ordinate UK civil space activities.
- **1986** The BNSC decides not to fund human spaceflight and focus instead on areas with immediate benefit to industry.
- **1991** Helen Sharman becomes the first Briton in space with the trip financed by Russia and private funds.
- **2010** The UK Space Agency is established with responsibility for space research.